Marine Engineering
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Vol. XXXII **FEBRUARY, 1927** **No. 2**

	Page
Editorial Comment A Mussolini needed. Corrosion. The new cruisers. Mail contracts. Wear in marine machinery. *Marine Engineering and Shipping Age*, February, 1927.	61
Ferry Steamer, Passenger and Automobile Plans and description of new Jamestown and Newport, R. I., ferry steamer. Propelling machinery formerly used on yacht *Aloha*. 4 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	65
Tramp Steamer Giving Way to Ocean Liner Ocean freight rates less affected by general trader competition than formerly. Three-fourths of world's liner tonnage increase since 1924 represented by American ships. *Marine Engineering and Shipping Age*, February, 1927.	69
Sale of Government Tonnage in 1926 *Marine Engineering and Shipping Age*, February, 1927.	69
Naval Appropriations Bill *Marine Engineering and Shipping Age*, February, 1927.	69
Soot Blower, Champion (Rear End) *Marine Engineering and Shipping Age*, February, 1927.	70
Tug Boat New York Central No. 34, Diesel Electric Plans and description of the most powerful oil electric tug boat in the world. Power plant consists of two 400 horsepower generator sets. 7 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	71
Great Lakes Technical Committee *Marine Engineering and Shipping Age*, February, 1927.	73
Motorship Augustus, Launching of The By Our Special London Correspondent. Brief description of largest motorship in the world recently launched in Italy. Gross tonnage of the *Augustus* is about 32,000 and the horsepower 28,000 developed by M. A. N. engines on 4 screws. 1 illustration. *Marine Engineering and Shipping Age*, February, 1927.	74
Shipping Board Appropriation *Marine Engineering and Shipping Age*, February, 1927.	74
Ferry Steamer, Catamaran Type One hundred and fifty foot river ferry steamer propelled by radial paddle wheel between hulls. Accommodations for black and white passengers and automobiles. 2 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	75
Clutch for Marine Service, Disk *Marine Engineering and Shipping Age*, February, 1927.	76
Guide Blades, Power Reduced by *Marine Engineering and Shipping Age*, February, 1927.	76
Motorships with Double Acting Diesel Engines By Our Special London Correspondent. Machinery details of the motorships *Stentor* and *Phobos* propelled by novel type of Werkspoor 4 cycle engine. 4 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	77
Repairs to Tanker Agwisun *Marine Engineering and Shipping Age*, February, 1927.	79
Cutting Metals Under Water By L. F. Hagglund. Abstract of paper read before International Acetylene Association describing method of combining electric arc with oxygen for cutting metals under water. *Marine Engineering and Shipping Age*, February, 1927.	80
Diesel Engines, Developments in Small New line of Fairbanks-Morse Diesel engines in 10 horsepower cylinder size. Small Diesel now claimed to be on a par with large main units. 4 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	81
Trial Results of S. S. King George V Results of fuel consumption trials given in paper read before North East Coast Institution of Engineers and Shipbuilders. *Marine Engineering and Shipping Age*, February, 1927.	83
Diesel Engine, The Hamilton-M.A.N. Marine Detail drawings and description of 4 cylinder double acting two cycle engine of 3,300 horsepower built for the Shipping Board. 7 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	84
Standards Committee, Annual Meeting of *Marine Engineering and Shipping Age*, February, 1927.	87
Corrosion By W. Bennett. Abstract of paper read before Society of Naval Architects and Marine Engineers by Lloyd's senior surveyor in New York giving results of extended investigation covering corrosion in shell plates and rivets. 13 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	88
Ferryboats, Considerations in the Design of By Charles F. Gross and Charles Green. Outstanding problems which have arisen in the design and operation of passenger ferryboats in service on San Francisco Bay. 13 illustrations. *Marine Engineering and Shipping Age*, February, 1927.	97
Kink, A By G. W. Stutt. How to renew gasket in leaky manhole plate while raising steam in Scotch boiler. *Marine Engineering and Shipping Age*, February, 1927.	105
Shipping Board Finds Subsidy Necessary By Harold F. Lane. Report to the Senate in reply to a resolution asking for shipping policy declares subsidy of some form necessary for private operation of American vessels in foreign trade. *Marine Engineering and Shipping Age*, February, 1927.	106
Questions and Answers for Operating Engineers Information relating to the operation and maintenance of boilers, engines and auxiliaries. *Marine Engineering and Shipping Age*, February, 1927.	108
Questions and Answers	110
New Books	111
Letters to the Editors	112
Personal	113
Obituary	115
Shipping and Shipbuilding News	116
Great Lakes Notes	119

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A Mussolini Needed

IF ever a national industry needed the benefits of mutual confidence and understanding among its members and the strength that comes from union, American shipbuilding needs them today.

Whatever criticism may be made of his methods, the fact boldly stands out that Mussolini saved Italy from industrial chaos. American shipbuilding needs a Mussolini to put its house in order; a man strong enough to inspire confidence, of unquestioned integrity and singleness of purpose who can place the industry on a rational basis. If it is to continue, lack of confidence must, first of all, be replaced by mutual trust, by the realization that by unified and concerted action only can a firm basis be reached and the business as a whole conducted in a normal and sensible manner. The present intolerable conditions must come to an end.

One has but to review the course of the industry during the past five years, the contracts that have been taken and the financial results that have ensued, to realize the absolute folly of proceeding further, in the same way, on the same road. To anyone with a fair working knowledge of shipbuilding and shipbuilding costs it appears unquestionable that not one major contract has turned in a profit, that many have taken care of but a small portion of overhead expense and that some were taken at a price which makes it appear doubtful if even direct material and labor costs were fully covered. The absolutely suicidal nature of such methods in the conduct of a business is too obvious to call for any explanation. Its practice has already resulted in the establishment, in the minds of present and prospective shipowners, of an entirely false basis of value for new vessels; if persisted in, it can only lead to bankruptcy.

If the maintenance of the merchant marine is to demand a price that involves the eventual destruction of the shipyards as going concerns, it is too high a price to pay. Such a result would be disastrous to the shipping industry as well as to the yards themselves. It could not in the smallest degree be justified by the possible saving to the shipowner resulting from the construction of vessels at prices less than their actual cost.

It will be readily enough admitted that with shipping in its present state every possible dollar must be saved by the shipowner both in operating his present vessels and in the building of new ones, but nothing is more certain than that the latter cannot continue to be supplied at less than cost.

The present situation cannot long continue without disastrous results and it is high time that the shipbuilders and shipowners arrived at a mutual and reasonable understanding and put a stop to the practice of making bids varying 25 or 30 percent on vessels the actual cost of which they must know, making every allowance for possible variations, within, at the outside, 10 or 12 percent. The shipbuilders individually must be fully aware of the utter folly of taking work regardless of its cost. Certain emergencies may occasionally warrant the taking of work at cost in order to hold together an organization or bridge over a lean period when other and more remunerative work is in sight; nothing can justify a policy, the continued and persistent practice of which leads nowhere but to ruin.

If new ships are to be built, and nothing is more certain than that they will have to be, in the near future, if this country is to retain the shipping business which it at present has, it would seem far better for the yards to conserve such resources as they now have rather than waste them in a useless and suicidal cutting of each other's throat —and much of the recent bidding amounts to nothing else than this. In the ordinary course of events certain ships will *have* to be built and we believe that the owners, if made to understand the present critical situation, will be quite ready to pay a fair price for them. They cannot, however, be expected to refuse low tenders, if such continue to be made.

In the past, other industries have been saved from wreck by the steadying hand of a strong man at the helm. Such a man is needed to steer the shipbuilding industry away from the rocks towards which it is heading.

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Corrosion

ELSEWHERE in this number there is printed an abstract of the paper on corrosion, read last fall before the Society of Naval Architects and Marine Engineers by Mr. William Bennett of Lloyd's Register of Shipping.

Not only from the point of view of the intrinsic merit of the paper itself, the evident care and deep study involved in its preparation but because of its timeliness and the very great importance of the subject treated as well, this paper easily takes place as one of the best that has been presented before the society in its 33 years of existence.

In a previous review mention was made of the very prejudicial effect of intensive riveting during the war period upon the lasting qualities of steel hulls. There can be little doubt but that hurried and unskilled riveting contributed very largely to present rivet troubles, but Mr. Bennett makes it clear that these troubles are by no means confined to ships built during and shortly after the war. A factor of quite different type has recently appeared in the problem of hull corrosion which it is possible may eventually prove to be the principal offender. It has been found that a small amount of copper alloy in structural steel improves the weather resisting qualities of the latter. This copper bearing steel is being specified by railroads and similar industrial organizations in increasing quantities with the result that copper bearing scrap is finding its way back to the steel mills and all steel now turned out has, or at least may have, some copper content.

Unfortunately the weather resisting qualities imparted by the copper tend to reverse themselves when the plate which contains it is immersed in sea water. The electrical potential of a steel rivet as compared with the plate surrounding it tends to rise during heating and driving; copper in the plate increases this difference in potential with the result that the rivet point is more or less rapidly eaten away. It thus seems evident that by raising the potential of the plate or lowering that of the rivets the electric current passing from the one to the other may be so reduced as to stop or at least greatly reduce electrolytic action and the consequent corrosion. The quality of plate cannot, apparently, be greatly changed and it becomes necessary to reduce the potential of the rivet. This can be done by substituting, for the usual steel rivets, iron rivets or steel rivets having a fairly high copper content. The iron rivet has a relatively low potential to start with and the additional advantage that it is less likely to be burned or have its potential raised during the process of driving up. Rivets made from copper bearing steel have been used to some extent, but must still be considered in the experimental stage. That they can be made to reduce the difference in potential between rivet and plate seems certain; their practical use, on a large scale, has yet to be tried out.

The use of iron rivets in shipbuilding while quite general in Great Britain has come to be very limited in this country, steel rivets being used almost exclusively. For a large part of a ship's structure the steel rivet, if of good quality, is entirely satisfactory. For the bottom shell, particularly in vessels which scrape the bottom, and such other portions as are constantly in contact with salt water, recent experience in ship repairing has created a tendency to return to the iron rivet, particularly in oil tank vessels, and certain of the oil companies are using iron rivets entirely in their repair work, apparently with very satisfactory results.

So far as the writer's experience goes, the main objection to iron rivets in the past has been their additional cost which, in a large vessel, runs into an appreciable amount of money, but such additional cost appears a matter of rather minor importance when compared with that of some of the repair jobs mentioned in Mr. Bennett's paper, to say nothing of the delay and loss of time which inevitably resulted from them.

The New Cruisers

AGAIN shipping, this time naval shipping, has been treated as a political football. There is not the slightest question but that the majority of the members of the Congress desire that this country shall, as fully as possible, maintain the position assigned to it by the disarmament treaty. Notwithstanding this very patent fact, the minority floor leader in the House, himself in favor of strengthening the navy, could not resist the temptation to "play politics" and twitted the majority over its apparent break with the President, the result being that the appropriation for new cruisers was disapproved. As seems ever to be the case with our national legislators, matters of great national concern and of public policy receive scant attention when a remote chance of possible political advantage appears to enter into congressional debate.

This paper has little or no concern with national politics, as such. It has, however, a vital interest in the public welfare as affected by the maintenance of efficient naval forces, a policy to which the country obligated itself when it became a party to the disarmament agreement. Were the other parties to the treaty showing any inclination to consistently and sincerely carry out its terms or were this country in such financial straits that the building of additional vessels involved an expense which we could ill afford to assume, then the opposition to new cruisers might have some real and tangible grounds for existence. But neither of these conditions is in the slightest degree borne out by the facts. The foreign parties to the treaty are adding cruisers to their fleets, already more numerous and more powerful than our own, while so far as ability to pay the bill is concerned one has but to consider the various proposals now being made to reduce federal taxes or rebate them to the tax payer to find the answer.

It is, of course, possible that the Senate will put the cruisers back into the Naval Appropriation Bill, in which case the House may reverse its action. The regrettable aspect of the whole operation lies in the fact that members of the Congress even when thoroughly convinced of the national importance of and need for certain action are ever ready to subordinate it to the chance of gaining political advantages over their opponents, however slight and trivial this advantage may be.

With matters pertaining both to the navy and to mercan-

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tile shipping similar situations too often arise. Our navy and our merchant marine are and always have been of major importance and this importance will become larger and more pressing as time goes on. It is about time that shipping had some direct representation in the halls of the Congress, men who from personal experience are conversant with its needs and will see to it that shipping questions are treated with the consideration they deserve and are not made the sport of every country lawyer or professional politician who wants to bring himself to the attention of "the folks at home."

Mail Contracts

OF all the various provisions of the Merchant Marine Act of 1920 about the only one which has been made actually effective, and which has proved of value in the maintenance of the merchant marine, is that which provides for the making of contracts with private shipowners for carrying the mails.

The act of 1920 was without doubt the result of a sincere recognition on the part of both great political parties of the necessity, for the national defense and for the proper and unrestricted growth of both foreign and domestic commerce, of the maintenance and building up of the merchant marine. Many of the provisions of the act have fallen into innocuous desuetude; one at least has after due consideration been made effective but now even that is in danger of being allowed to lapse. Lacking mail contracts, none of the lines of steamers having the greatest national value can be maintained. Their continuance is dependent upon a fixed and dependable government policy; their operators must know just what business the government is to give them and just what pay they are to receive for carrying out the various contracts. All this was provided for in the Act of 1920—in effect a statement of national policy.

Now, certain of the sensitive country members of the Congress have discovered, or think they have discovered, the seeds of subsidy legislation in the mail contracts and funds to provide for their continuance were, in consequence, not provided in the Post Office Appropriation Bill as reported to the House.

Nothing is more certain than that busness such as that involved in the operation of a steamship line cannot be undertaken unless its organizers feel fairly certain of the financial backing it is to receive. It is equally certain that the lines in question cannot be operated without the income derived from carrying the mails. The Act of 1920 committed the government to the furnishing of this support—made it a national policy; something to be depended upon. If national policies are to be interrupted or set aside every time a member of the Congress thinks that a little personal advertising is in order then it is more than useless to attempt any consistent and sustained action in any line of endeavor. This country needs more than anything else in the promotion of its shipping stability of purpose in place of vacillation and whim on the part of its legislators. Until the Congress comes to a full realization of this fact, any shipping enterprise bearing even a remote business relation with government control or in any measure dependent upon government support and backing can have, at best, but a precarious existence.

Wear in Marine Machinery

DEPRESSION in such an operative business as shipping may at least have one beneficial result—it is likely to concentrate attention upon and stimulate action in regard to certain details of operation which, while always of importance, are likely not to receive the consideration due them when business is good and profits accrue as the result of relatively small effort. The keen competition brought about by the conjunction of too many ships with too little work for them to do not only calls for the elimination of every source of waste but may also give an ordinarily overcrowded operative staff time to deal systematically and intelligently with many matters which in more prosperous times receive but scant attention or are neglected.

Thus one finds, during the past few years that more than ordinary attention has been given to increasing the economy and efficiency of marine machinery. Particularly has the consideration of engineers been devoted to the reduction of the costs of maintenance and upkeep—to the elimination to the greatest possible extent of wear. Wear, as applied to mechanical contrivances and machines usually means abrasion in some form, a rubbing away of surfaces in physical contact. Applied to the machinery of a ship it means much more for added to the rubbing away of bearings, the possible crystallization and breaking of moving parts, are chemical and electrolytic action—far more significant and far more costly.

The possible sources of wear and waste in marine machinery are so numerous that a complete list would not only be cumbersome but difficult to compile. There are, however, certain major offenders which stand out from the many minor culprits and to which attention must be given, even in the best and most prosperous of times.

Undoubtedly the chief cause of wasting away aboardship—of wearing out, to stick to the original text—is metallic corrosion, both as regards hull and machinery. Of the latter the steam condenser is probably the part most susceptible to damage from this particular form of destructive action. Of recent years the condenser, for some reason (probably several reasons), has been giving to marine engineers more than its due share of trouble. Certainly condenser tubes and their ills have received a larger amount of attention than any other member of the family since the war left us with a large fleet of hurriedly constructed ships but it is not clear that the troubles experienced have been mainly due either to poor material or faulty workmanship. The principal cause of recent condenser troubles has been due in very large part to the more arduous service which the condenser has been called upon to render as a result of the widespread use of the steam turbine with its accompanying high vacuum and rapid and turbulent circulation of cooling water. Apparently a major portion of the tube damage arising from these causes is due to an undue

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liberation of the entrained air in the cooling water in certain of the tubes, this, in turn, arising from unequal flow. At least a partial remedy has been found in the fitting of ferrules at the entering end of the tubes, this tending to equalize the pressure in the waterbox and produce a more even flow in all of the tubes. It has also been observed that new tubes are much more susceptible to corrosive action than ones which have been some time in service and that if renewal in the parts of the condenser where the most active deterioration is going on is made with tubes which have already had some service in other parts of the condenser, the latter being replaced by new tubes, the result is a much greater average tube life. Good results have also been obtained by spraying the interior (water side) of the tubes with a bitumastic mixture, forming a thin protective coating. Extensive experiments are also underway with new types of tube material, notably with nickel alloys, which give good promise. Altogether it seems probable that the condenser troubles arising from the use of high pressure steam and high vacua are in a fair way of being satisfactorily solved.

A second cause of deterioration, the results of which are apparent through the whole train of boilers, engines and condensers, is impure feed water. With the increasing use of high pressure steam and watertube boilers the necessity of providing pure feed water has become a problem of much greater importance—the "wearing" possibilities of impure water in conjunction with watertube boilers, superheaters and turbines are almost limitless. The immediate and primary effect of impure feed water is upon the boiler itself, causing as it does loss of efficiency by deposits on heating surfaces and consequent reduction of heat transference and also the wasting away and burning out of these surfaces for the same reason. While tight condensers doubtless form the first line of defense against impurities in the feed water, efficient filters or oil separators are of scarcely less importance and have been highly developed in recent years.

A secondary but far reaching effect of impure feed is its tendency to cause priming of the boilers and wet steam. The first effect of wet steam is likely to be found in the superheater. If the percentage of moisture is high enough, the superheater loses its proper function and becomes merely an addition to the heating surface of the boiler proper. In any event its efficiency is reduced directly in proportion to the amount of moisture brought to it by the steam. We are now, however, concerned with wear and not with loss of efficiency in the ordinary sense. Superheaters are peculiarly susceptible to damage from foreign substances in the steam. The same sort of action which causes wasting away of boiler tubes, tube sheets and furnaces will attack the superheater with even greater rapidity, if impure water is brought over with the steam, the slightest coating or deposit on superheating surfaces leading to serious overheating and burnt out tubes or elements. Recently a device was described in this paper which automatically detects and gives warning of the presence of moisture in steam presumably superheated, thus calling the engineer's attention to the presence of moisture in the superheater, immediately it appears there. To the same end, steam driers, have in some instances been fitted between boiler and superheater, but so far as we know, no such device has been used in an American vessel.

Going beyond the boiler and superheater to the engine or turbine the possible destructive effects of wet steam are more obvious. With a reciprocating engine wet steam, aside from its effect upon thermal efficiency, can do no great damage excepting of course the case when excessive priming or too high a water level in the boiler results in masses of solid water being carried over into the engine but this can hardly be considered wet steam in the usual sense. A certain amount of moisture is, indeed, considered an advantage by many engineers on account of its lubricating effect in the high pressure cylinder. In some of the earlier installations where superheaters were fitted with moderate superheat, 50 degrees or less, the practical result was a constant supply of dry, saturated steam to the engines, there being little or no superheat at the throttle. Under this condition the engine operated efficiently but, as has been mentioned, some objection was made on account of increased difficulty in lubricating the high pressure cylinder. If, however, superheaters are to be fitted in conjunction with reciprocating engines, it should be with the intention of actually supplying superheated steam and not to act merely as steam driers, for with pure feed water, boilers of sufficient size and adequate and properly laid out piping there should be no great difficulty in supplying practically dry and saturated steam to the engine, and the superheater unless functioning in its proper manner is an addition of doubtful value.

Turning to the turbine, there can be no question as to the damaging effect of moisture or foreign substances on the blading. Fortunately turbines are usually operated by steam having a considerable amount of superheat and the tendency is constantly towards higher temperatures. Thus wear of blading due to entrained water in the steam seems likely to be pretty well eliminated but in its place the physical effect of excessive temperature upon the blading material rises as a new problem which must be dealt with. On the new high pressure steamer *King George V* this latter condition has been met, apparently with entire success, by the fitting of Monel metal blading in the high pressure turbine.

A few of the causes of wear, particularly as concerns steam machinery, have been mentioned. The cure of all of them lies in care, watchfulness—and cleanliness. The latter is a very general and much abused term, but it is certain that in no one way can the engineer reduce the upkeep charges arising from wear and deterioration more effectively than by seeing to it that the machinery under his charge and the compartments in which it is installed are kept clean and fresh. Care and cleanliness are usually found in company with successful operation. The rule does not always hold but in the majority of cases a clean ship proves to be an efficient one.

The internal combustion engine has its own peculiar difficulties of wear, maintenance and upkeep. These we shall touch upon in a later article.

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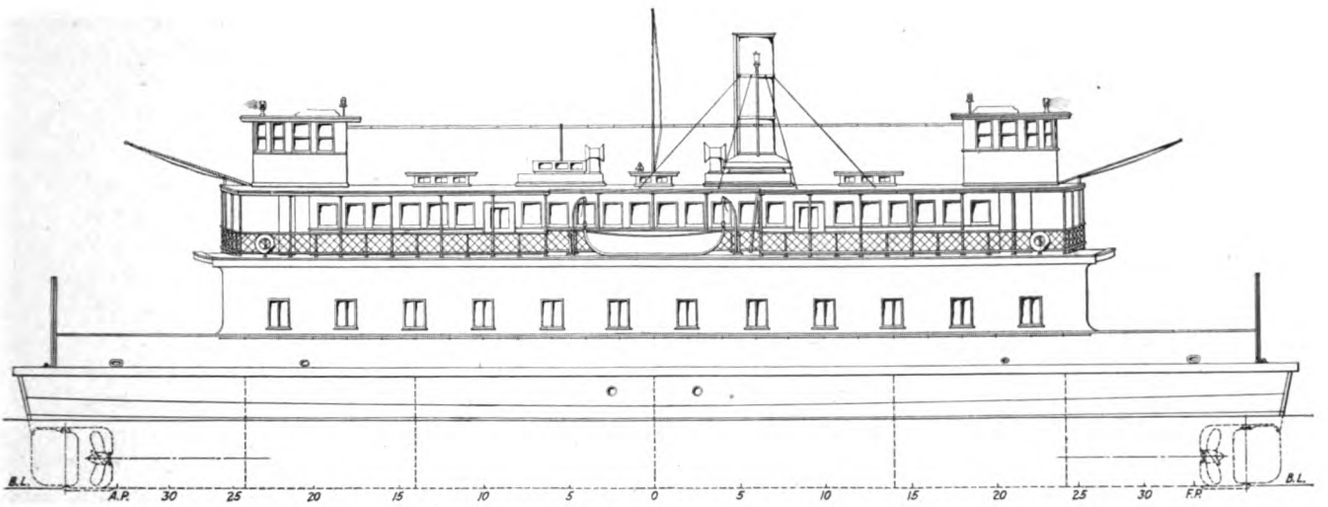

Outboard profile of new ferry steamer

New Jamestown and Newport Ferry Steamer

Vessel can carry 40 automobiles of average size—Propelling machinery formerly used on yacht Aloha

THE vessel shown by the accompanying illustrations is being built at the Fore River shipyard of the Bethlehem Shipbuilding Corporation at Quincy, Mass.

The new ferryboat was designed by Mr. Albert F. Haas, naval architect, of Newport, R. I., for the service between Jamestown and Newport, R. I., a distance of about three miles, and is an interesting illustration of recent practice in this department of shipbuilding.

As will be seen from the drawings, the new boat is of the two decked type, the main deck being given over entirely to automobiles, of which 40 of average size can be carried in the four runways while very complete passenger accommodation is provided on the saloon deck above.

The main dimensions of the hull are as follows:

Length overall	150	feet	1¼	inches
Length, between perpendiculars	126	feet	0	inches
Beam, extreme (over guards)	48	feet	1¼	inches
Beam, molded	43	feet	0	inches
Depth, molded	14	feet	0	inches
Draft, designed	8	feet	3	inches
Displacement	480	tons		

The hull is divided into 6 watertight compartments by 5 transverse bulkheads and it is worthy of note that these bulkheads are complete and not provided with doors or other access openings, with the exception of that between the engine and boiler rooms, in which a vertical sliding watertight door operated from the main deck is fitted.

The engine and boiler casings and the house sides, between the main and saloon decks, are of steel, the latter being framed with lightened structural channels. The saloon deck and the houses above are of wood, the deck deriving its main support from lightened structural channels 12 inches deep and spaced at intervals of 8 feet to join with the house side framing before mentioned.

Propelling Machinery

The propelling machinery which had formerly seen service on the steam yacht *Aloha*, also a product of the Fore River yard, consists of a triple expansion engine and two Almy watertube boilers.

The engine has 3 cylinders, 12 inches, 19 inches and 30 inches in diameter respectively by 24 inches stroke and drives the two propellers through continuous lines of shafting, forward and aft. A Kingsbury thrust bearing is fitted forward of the engine and aft of it the ordinary thrust block taken from the *Aloha*. The propellers are 4 bladed, of cast iron and have a diameter of 6 feet 6 inches and a pitch of 8 feet 3 inches.

The two boilers have a combined heating surface of 2,896 square feet and a grate surface of 69 square feet, the working pressure being 200 pounds per square inch.

Auxiliaries

The following auxiliary machinery was installed:

1 Blake, vertical simplex, main feed pump, 8 inches by 5 inches by 12 inches.
1 Davidson, vertical simplex, auxiliary feed pump, 6 inches by 4 inches by 12 inches.
1 Blake, vertical featherweight, air pump, 6 inches by 10 inches by 8 inches.
1 McGowan, horizontal duplex, fire and bilge pump, 12 inches by 8½ inches by 12 inches.
1 Blake, vertical duplex, fire and ash ejector pump, 6 inches by 4 inches by 6 inches.
1 Blake, horizontal duplex, salt water sanitary pump, 5¼ inches by 4¾ inches by 5 inches.
1 Blake, horizontal duplex, fresh water sanitary pump, 4½ inches by 3¾ inches by 4 inches.
1 centrifugal circulating pump, 7½-inch suction, 5-inch by 5-inch engine.
1 General Electric, direct current generator, 6½-inch by 5-inch engine, with a capacity of 10 kilowatts.
1 General Electric, direct current generator, 4½-inch by 4-inch engine, with a capacity of 4 kilowatts.

In addition to the ordinary fire main and hose connection an "Invincible" monitor fire nozzle of 600 gallons per minute capacity is mounted on the upper deck, so that in case of emergency the boat may render efficient service in fire fighting.

The boat is now very nearly completed and will be launched shortly to enter service for the coming very active summer season.

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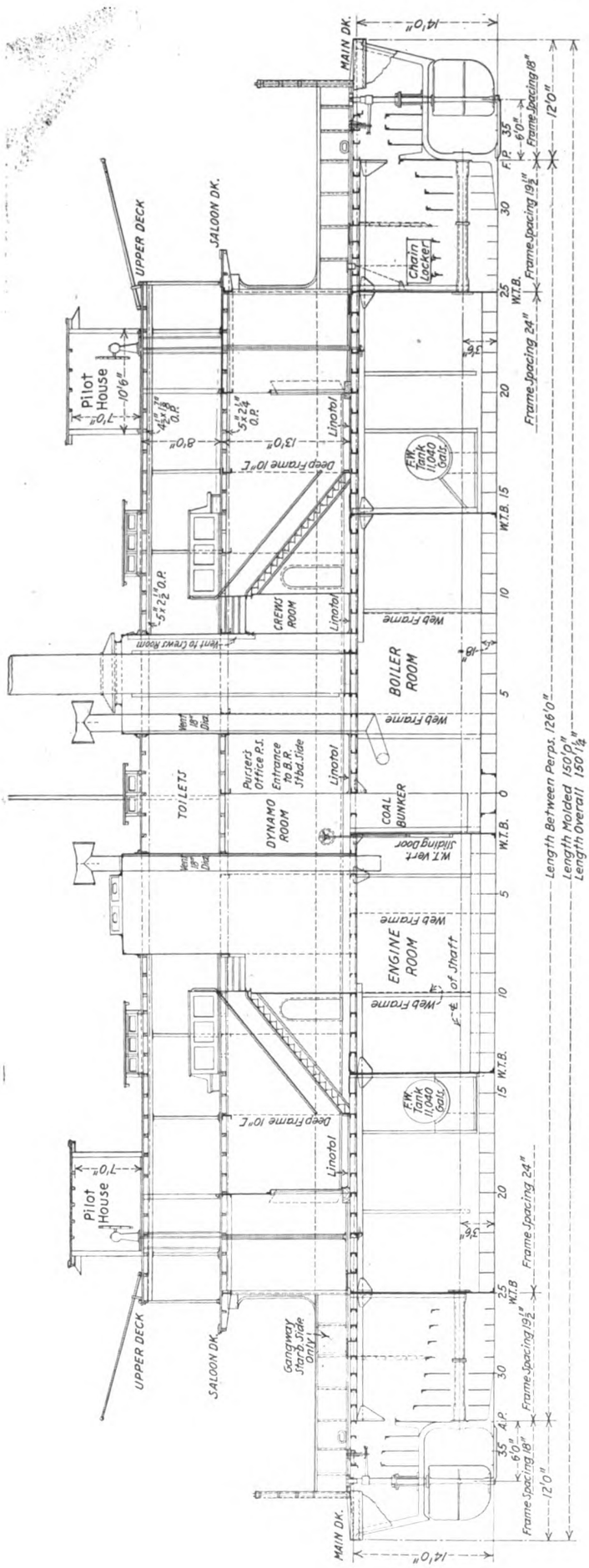

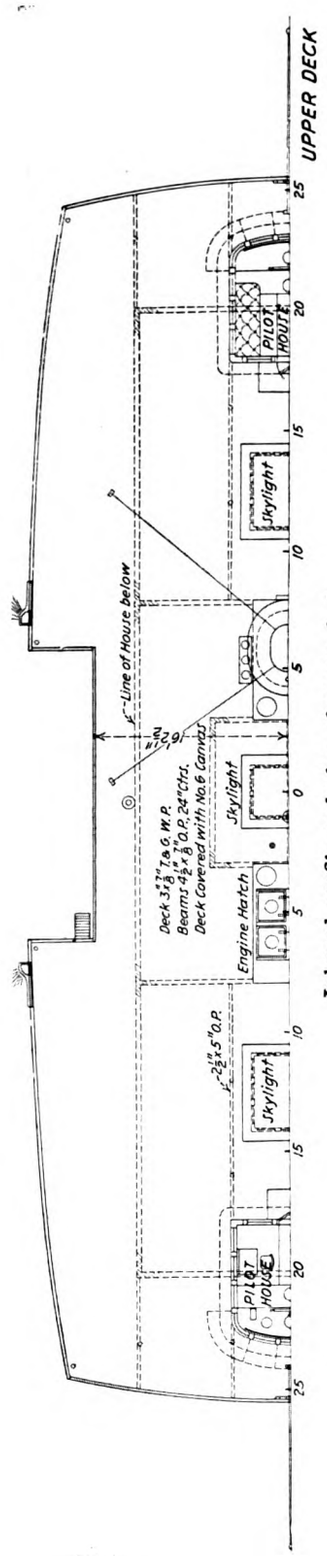

Inboard profile and plan of upper deck

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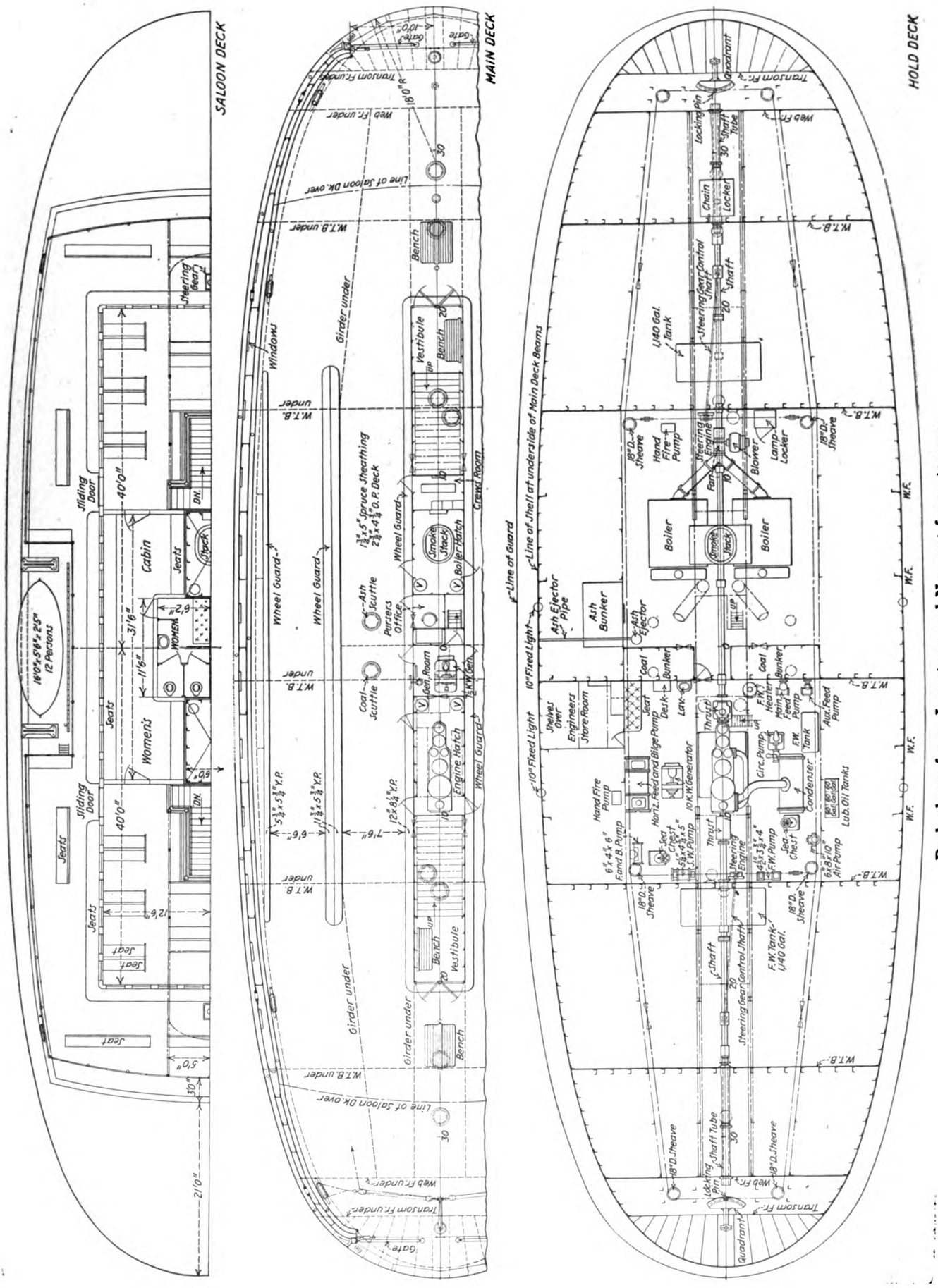

Deck plans of new Jamestown and Newport ferry steamer

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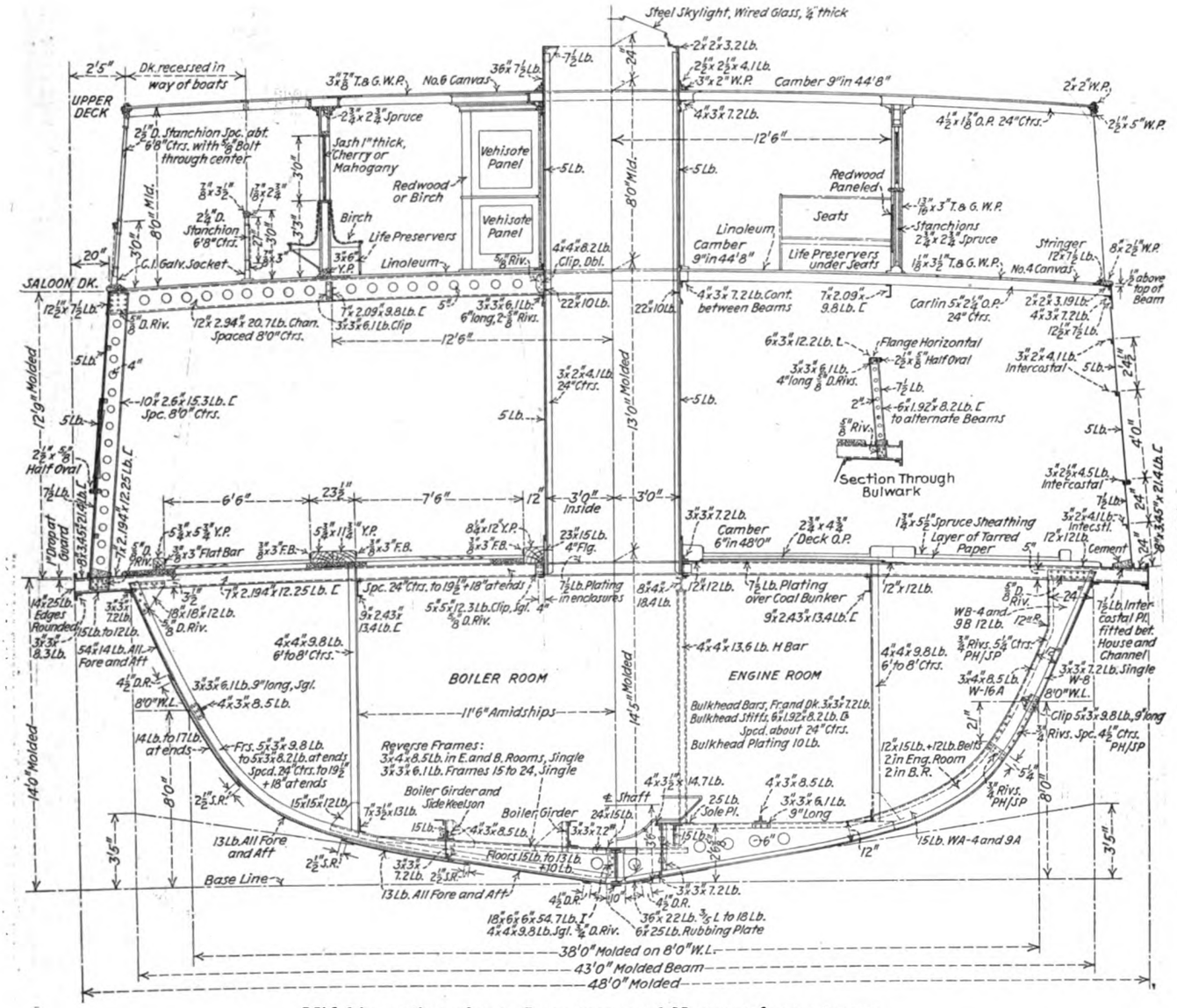

Midship section of new Jamestown and Newport ferry steamer

Senator Fletcher Proposes Permanent Policy of Government Operation of Merchant Vessels

A JOINT resolution committing the United States to a permanent and definite policy of owning and operating merchant vessels, with provision for a program of replacement, was introduced in the Senate on January 4 by Senator Fletcher of Florida and referred to the committee on commerce. The text of the resolution follows:

Whereas it is considered imperative an adequate American merchant marine be established and maintained; and

Whereas no definite plans or program can be expected to that end from private enterprise; and

Whereas the efficiency and permanency of such Shipping Board and Emergency Fleet Corporation are essential services which must be permanently maintained; and

Whereas the efficiency and permanency of such services will require the construction of new vessels, as they may be needed; and

Whereas the existing plan of operation, partially by the Government direct and partially through private operators as circumstances and good business judgment may justify, provided fair and reasonable contracts, making it to the interest of operators to save expenses and show results can be secured, is satisfactory: Be it

Resolved, etc., That the United States Shipping Board and Emergency Fleet Corporation shall continue indefinitely in the business of owning and operating merchant vessels in overseas trade to serve the needs of foreign commerce. That the Shipping Board shall have no authority to sell or dispose of any vessels owned except obsolete or incapacitated vessels, and then only on terms and conditions set forth in the merchant marine act of 1920, and that any power or authority heretofore given in respect to the sale of vessels by said board is hereby revoked and withdrawn, provided sales may be made of any vessels to American citizens on terms and conditions which will advance the purpose to establish and maintain an American merchant marine, where such sales can be made at the cost of such vessels, respectively, less a reasonable allowance for depreciation.

Resolved further, That the services now operated be regarded as essential services and shall be permanently maintained.

Resolved further, That a definite program of replacement and new construction shall be determined upon, which shall provide for the building of two express passenger ships of approximately 40,000 gross tons, to be operated with the *Leviathan* in transatlantic service, or the reconditioning of the *America* as one of such ships, and shall provide for the annual construction in the United States of approximately 26,000 tons of merchant vessels.

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Tramp Steamer Giving Way to Ocean Liner

Ocean freight rates less affected by general trader competition than formerly—Three-fourths of world's liner tonnage increase since 1914 represented by American ships

THE tramp steamer, operated on no regular schedule but free to come and go as cargo offered, is gradually but surely giving way to the ocean liner operated over specific routes on a regular schedule, according to E. T. Chamberlain, transportation expert, of the Department of Commerce.

In a trade bulletin released on January 10, Mr. Chamberlain points out that in 1925 out of every 100 transoceanic steel steamers, 73 were owned by corporations operating lines of steamers, and only 27 were tramps. Before the war the proportion was 42 tramps to every 58 liners. The gross tonnage of the liners in 1914 was 68 percent of the total of liners and tramps, while in 1925 this proportion had increased to 79 percent. When allowance is made for the higher speed and more frequent voyages of the liners, their capacity for cargo and passenger transportation was 81 percent of the total in 1925 compared with 71 percent in 1914.

Before the war, the report shows, the competition of tramp steamers with ocean liners, particularly in the carriage of bulk commodities, affected to a noticeable degree the ocean freight rates of the world. However, this situation has been changing since 1914. The growth of liner organizations, with their increasing capital and growing fleets, has weakened competition. Tramp ships have lost much of their former power in the regulation of freights, and steamship conferences, composed of liner organizations, now have increased authority in fixing ocean freight rates.

In 1914 there were in operation throughout the world 2,758 liners with an aggregate gross tonnage of 16,182,000; in 1925 the number of liners had increased to 3,374 and the gross tonnage to 23,483,000. During the same period the number of tramps declined from 2,143 with an aggregate gross tonnage of 8,300,000 to 1,503 with a gross tonnage of 7,603,000.

The world's gross liner tonnage in 1925, the report reveals, amounted to 32,000,000 as compared with 20,300,000 in 1914. Most of this increase is represented by American overseas tonnage which rose from 820,000 in 1914 to 8,738,000 in 1925.

Sale of Government Tonnage in 1926

SALES of government tonnage negotiated by the Shipping Board during the calendar year 1926 totaled 91 cargo ships aggregating 621,093 deadweight tons and 5 passenger-cargo vessels aggregating 70,730 gross tons, according to the statement prepared by the Ship Sales Department of the Emergency Fleet Corporation. The total cash consideration for these sales was $14,366,996.80.

In addition to the sale of ships, the board disposed of 5 dry docks for the sum of $420,000. All of these sales were made in accordance with the provisions of the Merchant Marine Act of 1920 and were in furtherance of the policy of transferring our merchant shipping to the control of private American citizens.

The sales for operation, as all of those during 1926 were, were in approximately the same volume as similar sales made during 1925. During that year, however, 199 ships were sold to the Ford Motor Company for scrapping.

The 1926 transactions included the sale of 17 cargo vessels, of 141,063 deadweight tons total, and all the passenger-cargo ships mentioned to private American interests under contracts that the ships shall be operated over specified routes in our foreign trade for periods of 5 years. The passenger-cargo ships, which comprised the American Oriental Mail Line, running from Seattle to the Orient, were sold to the Admiral Oriental Line of Seattle for the sum of $4,500,000.

Two complete services made up the principal part of the cargo ships sold for restricted operation. The American South African Line, comprising 5 vessels with 42,978 deadweight tons, was sold to a newly-formed concern styled as The American South African Line, Incorporated, for $777,901.80. This line covers American ports on the North Atlantic and ports of the South and East Coasts of Africa. The Pacific, Argentine and Brazil Line, with 6 vessels aggregating 51,403 deadweight tons, was sold to a new corporation bearing its name. Consideration for this sale was $295,515.50. Its operation over a route covering Pacific ports of the United States and ports on the East Coast of South America is likewise guaranteed for a 5-year period. Other sales for restricted operation included two 8,400-ton ships to the Export Steamship Corporation for use in the New York-Mediterranean and Black Sea trade; three 8,500-ton ships to the Grace Steamship Company for the West- South American trade; and one 4,100-ton steamer to the Colombian Steamship Company, Inc., for the West Indian trade. The total sales of cargo ships for use on established trade routes brought $1,376,775.80.

Cargo vessels sold for operation "as is" numbered 39 with aggregate deadweight tons of 238,428. The prices for these vessels totaled $3,866,729. Sales under agreement of the buyer to perform certain repairs or effect betterments to the ships numbered 23. The tonnage of these vessels amounted to 139,003 deadweight tons, while cash returns were $1,182,040.

The board also sold 12 tankers, of which 5 are to be converted to Diesel propulsion. Total tonnage of these tankers is 103,599 deadweight tons, and their aggregate cost to their purchasers, $3,441,452.

Naval Appropriations Bill

THE naval appropriations bill was reported to the Senate on January 17 by the committee on appropriations carrying a total of $320,020,534, or $5,267,854 more than was carried in the bill as it was passed by the House recently. Of this increase $1,200,000 is proposed for the beginning of construction on the three light cruisers authorized by the act of December 18, 1924. A similar amendment was defeated in the House.

Debate on the construction of three light cruisers was in progress in the Senate as this issue went to press.

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The Champion (Rear End) Soot Blower

THE regular use of permanently attached rear end soot blowers on Scotch marine boilers has been generally accepted as an economy. A lot of attention has been given to the blowing of all of the tubes but little if any thought has been given to the cleaning of the back sheet and crown of the combustion chamber. As will be noted in Fig. 1 the Champion (rear end) soot blower sweeps the rear sheet of the combustion chamber. In addition to this feature, the blower is interesting in that it actually has only one moving part which is of very rugged construction and will last indefinitely.

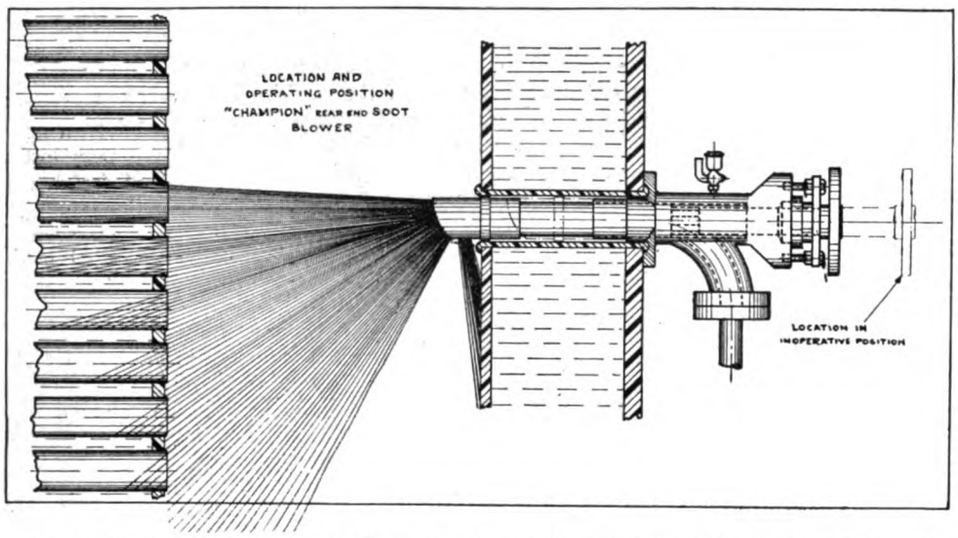

Fig. 1.—Section through combustion chamber of Scotch boiler showing how Champion soot blower sweeps the rear sheet and crown of the combustion chamber and all the tubes

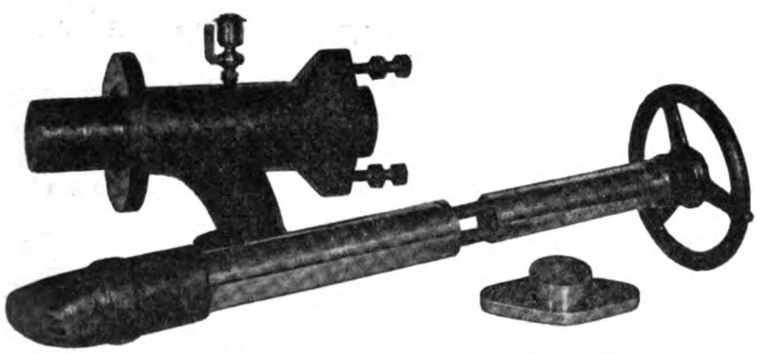

Fig. 2.—The three principal parts of the blower

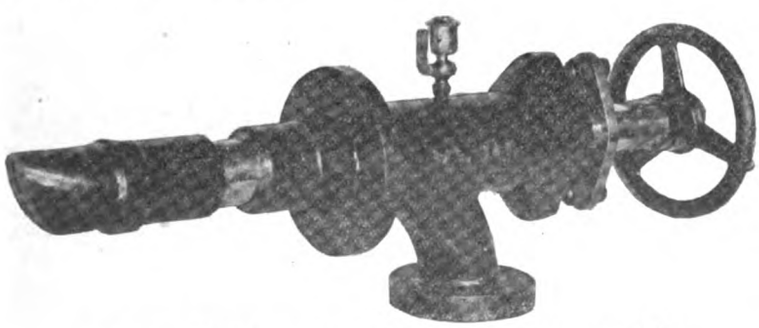

Fig. 3.—Champion soot blower completely assembled

The nozzle, which is exposed, during operation, to the hot gases of the combustion chamber, is a very heavy high-grade steel casting and will stand a lot of abuse. The revolving stem is of government bronze.

The three principal parts of the blower are shown in Fig. 2, and in Fig. 3 the blower is shown completely assembled. As will be noted from Figs. 2 and 3 there is no multiplicity of parts, but, on the contrary, the whole construction and assembly is extremely simple.

INSTALLATION

A staybolt which is nearest to a vertical and horizontal center of the tube nest is removed from each combustion chamber, holes reamed out and a 3-inch inside diameter stay tube installed. The blower is centrally located in this stay tube and bolted to the rear head of the boiler. The usual piping and drains are provided for.

OPERATION

To operate the blower, the nozzle is thrust forward into the combustion chamber by means of the hand wheel. This simultaneously opens the ports in the blower to steam. The hand wheel is then revolved one or more revolutions as desired, during which time soot is removed from all the tubes, the back sheet and the crown of the combustion chamber. It is important to note that the soot is blown out of the boiler along with the waste gases.

When the blowing operation is completed, the nozzle is pulled back into the tube which cuts off the supply of steam to the nozzle.

The absence in this blower of small moving parts and glands requiring frequent repairing or replacement is an advantage to the operating engineer not to mention the saving in repair costs to the owner.

The Champion (rear end) soot blower is manufactured and sold only by the Engineering Specialties Company, 39 Cortlandt Street, New York City.

Annual Conference of Supervising Inspectors

THE annual conference of the board of supervising inspectors of steam vessels, of the United States Steamboat Inspection Service of the Department of Commerce, was held in Washington during the last week in January. D. N. Hoover, president of the board, presided at the meetings.

During this conference, the members considered new fire extinguishers and life-saving apparatus that have been developed during the past year. Changes in the rules and regulations necessary for the better operation of the work of the Steamboat Inspection Service were under discussion. One of the major considerations presented to the conference for study was the study of fire-control on steam vessels. The conference opened on January 19 and continued through the 29th.

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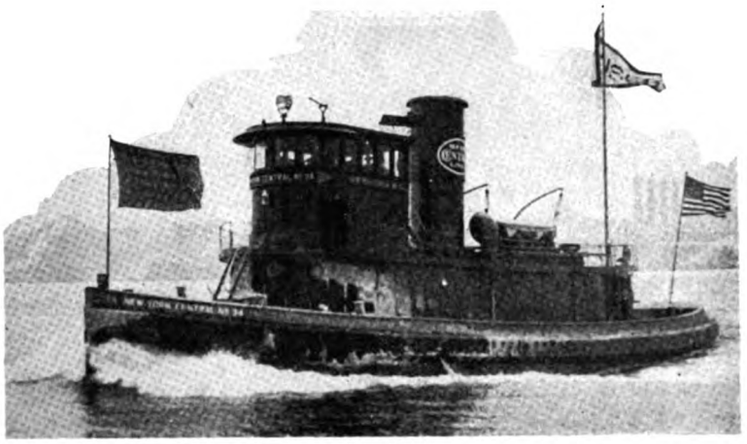
The Most Powerful Oil-Electric Tugboat in the World



Oil-electric tug New York Central No. 34

THE *New York Central No. 34*, recently put into service, has the distinction of being the most powerful oil-electric tugboat in the world. With its economical prime movers, pilot house control, flexibility of power manipulation and ease of maneuvering this tug is thoroughly representative of the modern trend in harbor craft.

The vessel was designed by the consulting naval architects, J. W. Millard & Bros., New York, and was built and outfitted by the Staten Island Shipbuilding Company. The hull was launched on October 15, 1926. While built for towing carfloats and barges in New York Harbor the tug is fully equipped to take care of itself under all operating conditions. Among the safety devices is included a complete fire fighting outfit.

Oil-electric drive for marine propulsion is distinctly a post-war development of marine engineering. In the last eight years, it has been very successfully applied to yachts, tugboats, ferryboats, dredges, cargo vessels, fireboats and tankers. The Ingersoll-Rand Company has taken an active part in this field of engineering, Ingersoll-Rand engines having been installed in the J. W. Van Dyke (the largest oil-electric ship afloat), in the tanker Brilliant and the three Van Dyke tugboats. In addition, Ingersoll-Rand engines are now being built for three large Atlantic Refining Company tankers, two tugboats for the Panama Canal Commission, a tugboat for the Long Island Railroad and three ferryboats for the Golden Gate Ferry Company. Interteresting direct drive installations include the ferryboat Hudson-Athens, the tugboats Hustler, Sonittep, Samson, Robert C. Bonham, Grace, Seba and New York Central No. 22.

Principal Dimensions

Length overall	108 feet	3¼	inches
Length between perpendiculars	96 feet	0	inches
Beam, molded	26 feet	0	inches
Depth, molded	13 feet	3	inches
Draft	9 feet	0	inches

Propelling Machinery

The oil-electric power plant of the *New York Central No. 34* consists of two Ingersoll-Rand type "PR" 6-cylinder, 4-cycle, 14-inch by 19-inch oil engines, each direct connected to a 270-kilowatt General Electric compound wound generator and a 30-kilowatt exciter.

These oil engine generating sets are non-reversing and operate at a constant speed of 265 revolutions a minute. The generators are connected in series and normally supply 480-volt direct current for the 650 shaft horsepower double armature, shunt wound propulsion motor.

The propulsion motor, which is direct connected to the propeller shaft, is capable of delivering full power at any speed from 115 to 145 revolutions per minute. This highly desirable characteristic for tugboat service is possible only with oil-electric drive.

Either one or both of these oil engine generating sets can supply power for either or both armatures of the propulsion motors on the propeller shaft.

Pilot House Control

The control of the vessel is entirely in the hands of the captain, stationed in the pilot house. He can maneuver the boat far more easily than he could an ordinary automobile. The control is flexible as to speed variations and is positive to the highest degree.

When maneuvering, the captain keeps one hand on the steering wheel and the other on the control lever. With these, he can vary the speed of the propulsion motor from 0 to 150 revolutions per minute for ahead and astern movements and can maneuver the tugboat as desired. The vessel can be turned around in almost its own length. Due to the conservative rating of the power plant, reserve power is always available for emergency use.

The direction and speed of the double armature propulsion motor are controlled by varying the voltage of the generators. The control levers, mounted on Cory pedestals, are located in both the port and starboard sides of the pilot house, convenient to the Hyde electric-type steering wheel. One lever controls the revolutions of the propulsion motor; the other, the ahead and astern direction of rotation. The levers are mechanically interlocked so as to prevent improper use.

Three meters show the electrical performance at all times. These instruments, which are mounted directly in front of the steering wheel, show (1) the motor field amperes, 25 to 150; (2) amperes line to motor (0 to 1,500 ahead and 0 to 1,500 astern); (3) the propeller revolutions per minute (0 to 150 ahead and 0 to 150 astern).

Solid Injection Marine Oil Engines

The Ingersoll-Rand oil engines, each of which develops 400 brake horsepower at 265 revolutions per minute, operate on solid injection of fuel oil. They are of the single acting, four cycle type. The fuel oil is sprayed into the

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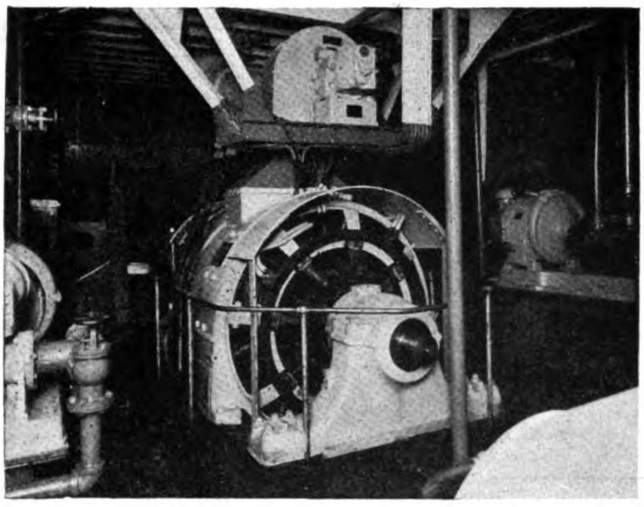
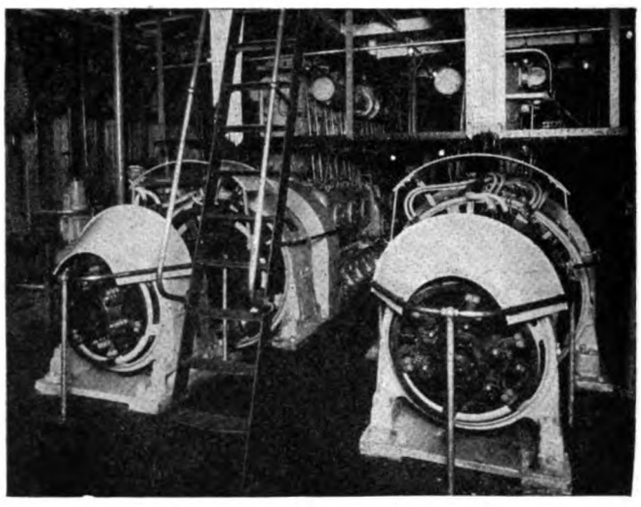


Propelling motor



The main engines, generators and exciters

center of the combustion chamber through two opposing nozzles. This results in complete atomization and mixture with the air that is drawn from the atmosphere into the combustion chamber during the previous revolution.

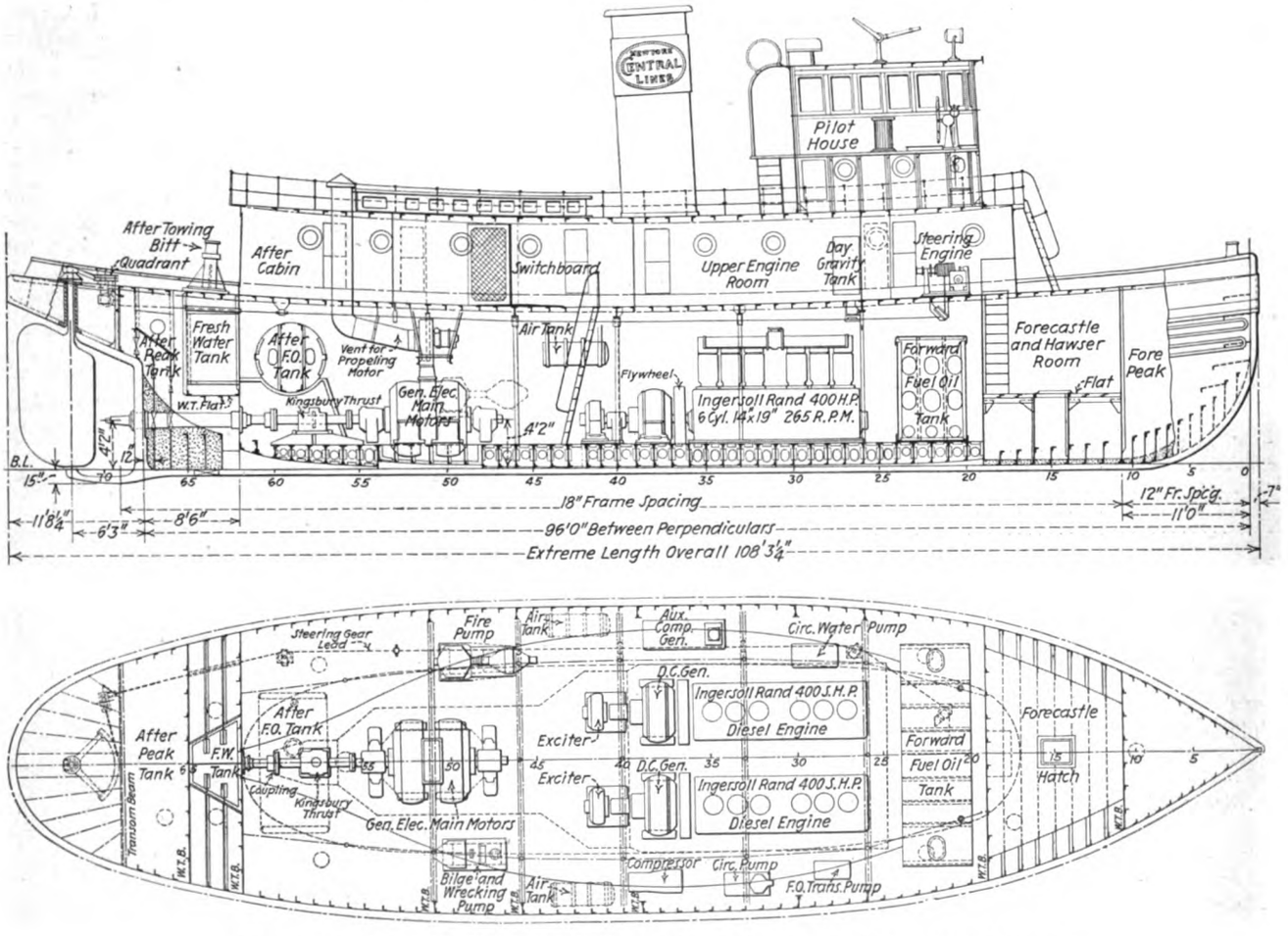
The combustion occurs without the introduction of electric spark or high pressure air, being produced as the vaporized fuel oil comes into contact with the oxygen and the heat of air compressed in the combustion chamber.

The simplicity and accuracy of this combustion principle, an exclusive feature of Ingersoll-Rand oil engines, is shown by the unusually high economy and freedom from smoke.

MOTOR-DRIVEN AUXILIARIES

The electrical equipment, built by the General Electric Company, is designed specially for marine application. All the engine room auxiliaries are driven by motors. The power is supplied, through the various switchboard combinations, by power take-offs from the exciters.

A 6-horsepower Hill Diesel engine, driving a 4-kilowatt,



Inboard profile and hold plan of the oil-electric tug New York Central No. 34

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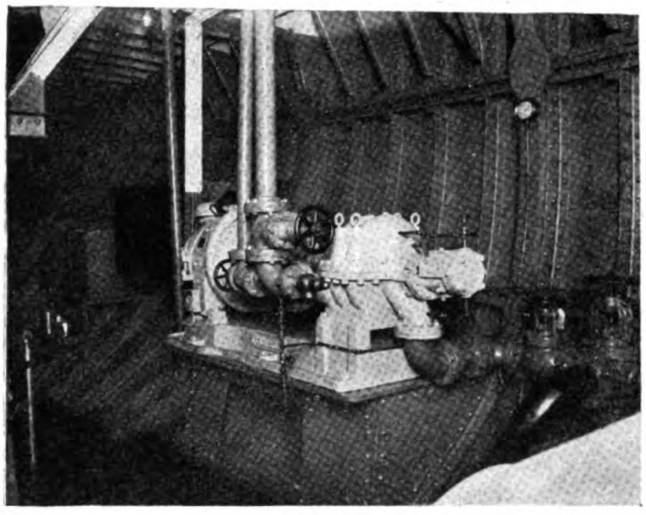
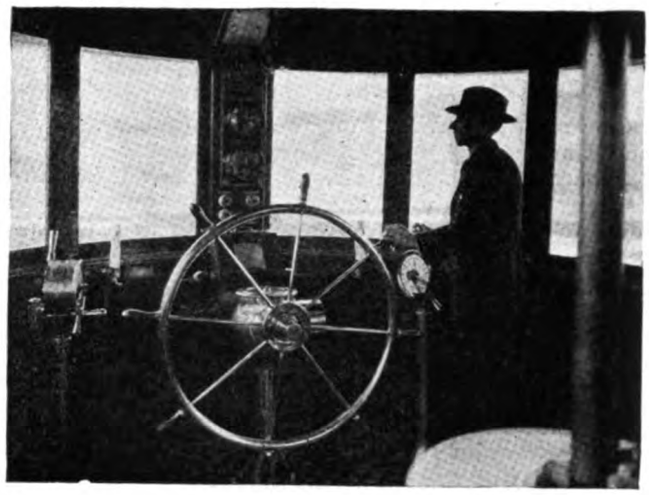


Fire pump



Pilot house control pedestal and electric steering wheel

120-volt direct current generator, supplies power and light for stand-by service. The auxiliary generating set is also connected through a clutch to an Ingersoll-Rand, type 15, 4½-inch by 5-inch air compressor, which charges the air tank when no other power is available to start the main engines.

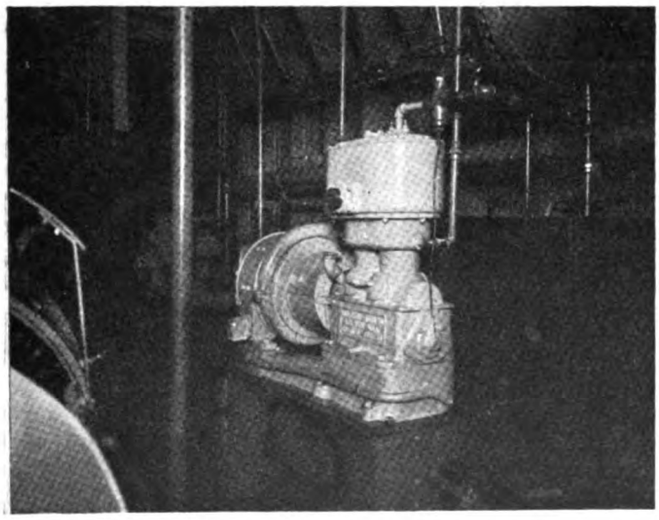
In Ingersoll-Rand, type 20, 6¼-inch by 2¾-inch by 5-inch compressor, driven by a 12-horsepower motor, charges the main air tanks from which the main engines are started.

A Cameron multi-stage centrifugal pump with a capacity of 500 gallons per minute against 150 pounds discharge pressure is driven at 1,700 revolutions per minute by a 75-horsepower motor. This pump supplies water to three nozzles included in the fire fighting apparatus.

A service pump of the Northern type (250-500 gallons per minute against a 30-pound head) is motor driven at 575-1,150 revolutions per minute through herringbone reduction gears. This unit is run at the minimum revolutions for pumping out the bilges; it can be used for pumping water out of barges at the maximum capacity.

Two circulating water and bilge pumps, Northern rotary type, are driven by 5-horsepower motors. These units have capacities of 175 gallons per minute against 30 pounds pressure.

A fuel oil transfer pump, Northern rotary type, is driven by a 2-horsepower motor.



Motor driven air compressor

The steering motor (1½ horsepower, 115-volt) operates at 550 revolutions per minute.

An American Radiator oil burning furnace is used for heating the pilot house, engine and crew quarters.

Except for size, the *New York Central No. 34* is the same in exterior appearance as the others of the fleet. The stack, which is not required, has been retained for housing the exhaust pipes of the engines and for ventilating the engine room.

Great Lakes Technical Committee

THE American Bureau of Shipping announced in its *Bulletin* of January-February, 1927, the appointment of a special technical committee to consider and decide on technical questions arising in connection with the classification of the hulls and machinery of vessels intended for trade on the Great Lakes.

The traffic on the Great Lakes has reached such importance that it employs a shipping tonnage which ranks very high in the world's merchant marine. In fact, if considered separately, the Great Lakes Marine in point of tonnage is exceeded only by that of Great Britain, Japan, France, Germany and Italy. It has more tonnage than is possessed by Sweden and Spain combined.

As these ships are operated entirely in fresh water, are subjected to a very limited depth of water at crucial points, have quicker turn-arounds in all ports and must operate through canals and locks, many technical points naturally arise in the design of these craft which are peculiar to this fleet.

Obviously the designers best fitted to decide on the questions involved are those whose years of training and experience have been devoted to the building and repairs of these ships. The following gentlemen, whose high standing in the profession will at once be recognized by those familiar with shipping problems, have agreed to serve on our committee, namely:

SUB-COMMITTEE ON NAVAL ARCHITECTURE

Chairman: PROF. H. C. SADLER, professor of naval architecture at the University of Michigan.

ALFRED G. SMITH, president, American Shipbuilding Company, Cleveland, Ohio.

JOHN A. UBSDELL, president, Great Lakes Engineering Works, River Rouge, Mich.

CHARLES C. WEST, president, Manitowoc Shipbuilding Company, Manitowoc, Wisconsin.

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EDWARD HOPKINS, vice-president, Toledo Shipbuilding Company, Toledo, Ohio.

SUB-COMMITTEE ON MARINE ENGINEERING

Chairman: HENRY PENTON, consulting engineer, Cleveland, Ohio.

GEORGE B. TURNBULL, vice-president, Great Lakes Engineering Works, River Rouge, Mich.

JAMES C. WORKMAN, chief engineer, American Shipbuilding Company, Cleveland, Ohio.

A. P. RANKIN, chief engineer, Manitowoc Shipbuilding Company, Manitowoc, Wisconsin.

JOHN O. CROFTS, chief engineer, Toledo Shipbuilding Company, Toledo, Ohio.

H. N. HERRIMAN, manager, Great Lakes Department of the American Bureau of Shipping, is a member, ex-officio, of the above-mentioned committees.

Launching of the Augustus, the World's Largest Motorship

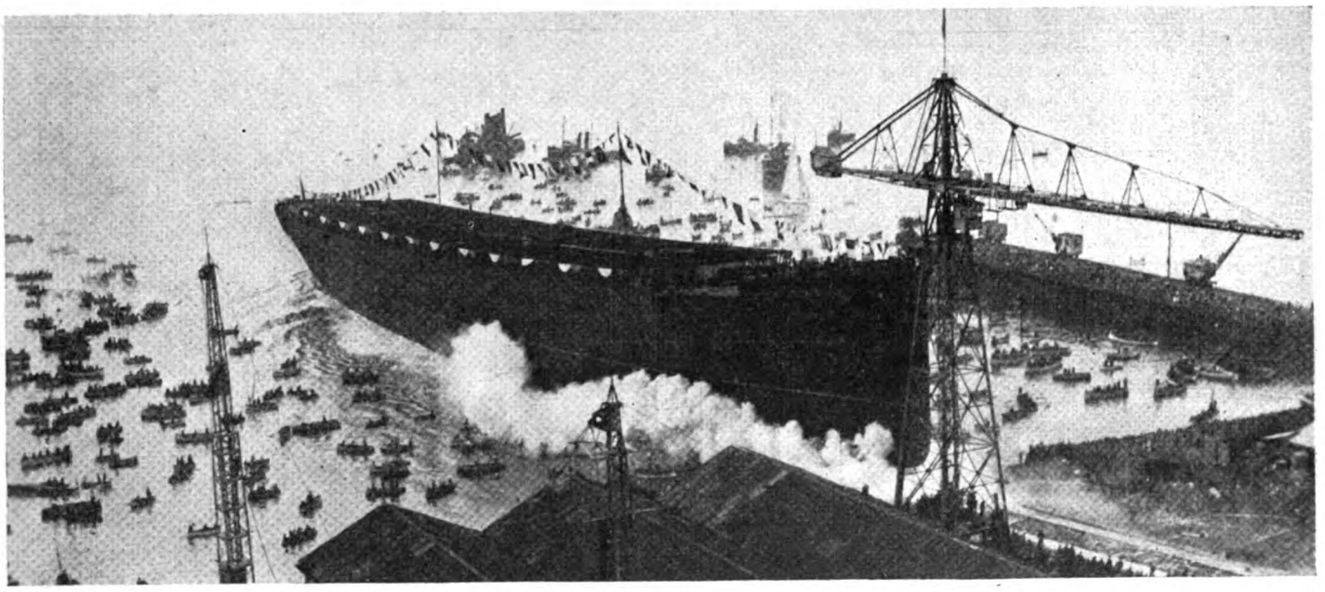
By Our Special London Correspondent

THE largest motorship under construction in the world is the *Augustus,* which is being built in Italy at the Ansaldo Yard near Genoa for the South American service of the Navigazione Generale Italiana. This vessel was launched in December with a great deal of ceremony as the Italians are naturally proud that a pioneer liner of this size has been built in their country although oil engine development has proceeded much more rapidly elsewhere than in Italy.

She will have a gross tonnage of about 32,000 and is 706 feet in length with a beam of 82 feet 6 inches. There will be accommodation for about 2,700 passengers and it is hoped to maintain a speed of 20¾ knots.

The *Augustus* is a quadruple screw ship and in it are to be installed four M.A.N. type double acting, two stroke engines each developing 6,250 brake horsepower with an overload capacity for 48 hours up to 7,000 brake horsepower. There will be eight Diesel-driven generators for the supply of electric power, and three of these are each of 600 kilowatts, the remaining five being of 280 kilowatts. The three large units will be used exclusively for delivering power to the large electrically-operated turbo blowers, two of which will be in service continually.

It is hoped that the *Augustus* will be placed in commission before the end of the year, and if possible, trials will be run about October or November.



Launching of the Italian motor liner Augustus of 32,000 gross tons

Shipping Board Appropriation

THE independent offices appropriation bill, as passed by the House on January 14, carries appropriations as recommended by the Budget Bureau for the Shipping Board and the Emergency Fleet Corporation for the fiscal year ending June 30, 1928. For the board itself the amount is $290,000, and for the Fleet Corporation the bill provides for $12,000,000, a reduction of $1,900,000 as compared with the appropriation for this year, but also provides for not to exceed $5,000,000 of the special appropriation of $10,000,000 carried in the same bill for 1927 and reappropriated. The unexpended balance of the special $10,000,000 fund is reappropriated for the purpose of enabling the Fleet Corporation to operate ships or lines which may be taken back from purchasers because of unjust discrimination and unfair competition by foreign shipowners.

An amendment to the bill offered by Representative Eaton of New Jersey providing for the construction of two new passenger vessels by the Shipping Board at a cost of not to exceed $15,000,000 each was ruled out on a point of order that it proposed new legislation in an appropriation bill.

The bill was also passed by the Senate on January 18 with an amendment changing the name of the Emergency Fleet Corporation to the United States Shipping Board Merchant Fleet Corporation.

A favorable report on the amendment to the merchant marine act of 1920 to bring the Shipping Board's construction loan fund up to the $125,000,000 originally contemplated was submitted to the Senate on January 15 by the Senate commerce committee, which stated that this fund should be maintained as a "means of developing an adequate merchant marine of up-to-date ships without any charge upon the federal treasury." It was stated that returns from the sales and operations of ships have not been sufficient to bring the fund up to $125,000,000 because the proceeds of ship sales have to some extent been diverted to current operations.

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Catamaran Type Baton Rouge Ferry

THE latest catamaran type ferryboat operating on the Mississippi River was recently delivered to the Baton Rouge Transportation Company of Baton Rouge, La., for ferry service between Baton Rouge and Port Allen. This is the *Louisiana,* designed by Cox & Stevens, naval architects and marine engineers, 341 Madison avenue, New York City, and built by the Howard Shipyards & Dock Company of Jeffersonville, Ind. Her principal dimensions are as follows:

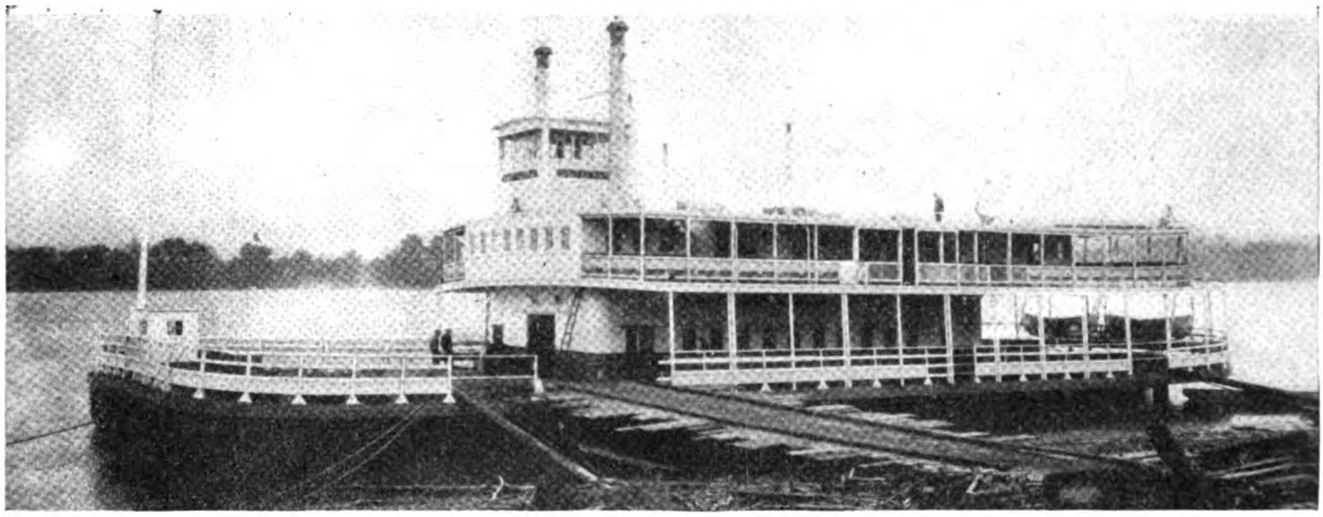
Length of main deck overall	150 feet		
Length between perpendiculars	144 feet	6	inches
Beam overall	64 feet		
Beam of hulls molded	18 feet		
Distance between hulls	19 feet		
Molded height of main deck at center-line above base line with 9-inch camber and 55-foot beam	9 feet	3½	inches
Draft, full load	4 feet	10	inches
Displacement, full load draft	620 short tons		

The radial type paddle wheel, 21 feet 2 inches diameter by 18 feet long, having 14 buckets each 30 inches wide is located between the twin hulls.

Steel construction is used throughout with the exception of the main deck covering, the boiler deck house and the upper deck, which are of wood. The hulls are divided into 8 watertight compartments by 7 transverse watertight bulkheads, each compartment being provided with steam syphons.

A steel house on main deck, 64 feet long by 30 feet wide, encloses the machinery.

At the forward end of the main deck there is an open deck space (49 feet long by 54 feet wide) for carrying motor trucks and other vehicles requiring excessive headroom. Vehicle access to the main deck is through two gangways having 16-foot clear openings, one on each side of the main deck located just forward of the deck house.



Catamaran type ferryboat Louisiana in service on the Miss'ssippi River at Baton Rouge

A sheltered passageway 16 feet wide extends along each side of the main deck house and connects the open deck space forward with a sheltered deck space aft, the latter being 37 feet long by 54 feet wide. These protected deck spaces are suitable for the stowage of automobiles and freight.

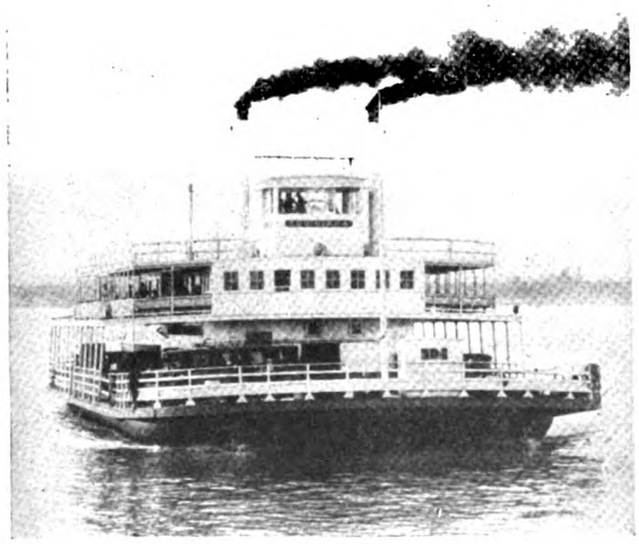
On the boiler deck, which is of steel construction throughout, are located two cabins of wooden construction for the accommodation of white and colored passengers. The white cabin is forward and the colored cabin aft. Both white and colored passengers have ample outside space without in any way conflicting with each other. Modern sanitary toilets for white and colored, male and female passengers, adjoin the respective cabins.

A concession stand adjoins the white cabin, having an opening into the cabin and into a passageway forward of the paddle wheel house.

Passenger gangways lead from the boiler deck direct to the upper deck of the landing docks, thus eliminating the necessity of passengers passing through the vehicle traffic on the main deck.

Two steel enclosed stairways at the after end of the deck are provided for access between the main and boiler decks.

An upper deck of canvas covered wood construction extends the full length and width of the passenger spaces on the boiler deck below, affording excellent shelter for the latter.



Bow view of the Louisiana

Propelling Machinery

The main propelling machinery consists of two Gillett and Eaton engines, 17 inches in diameter by 7-foot stroke, of the straight high pressure non-condensing type, designed for 220 pounds boiler pressure and fitted with steam reversing gear. Steam is supplied by two boilers, each 44

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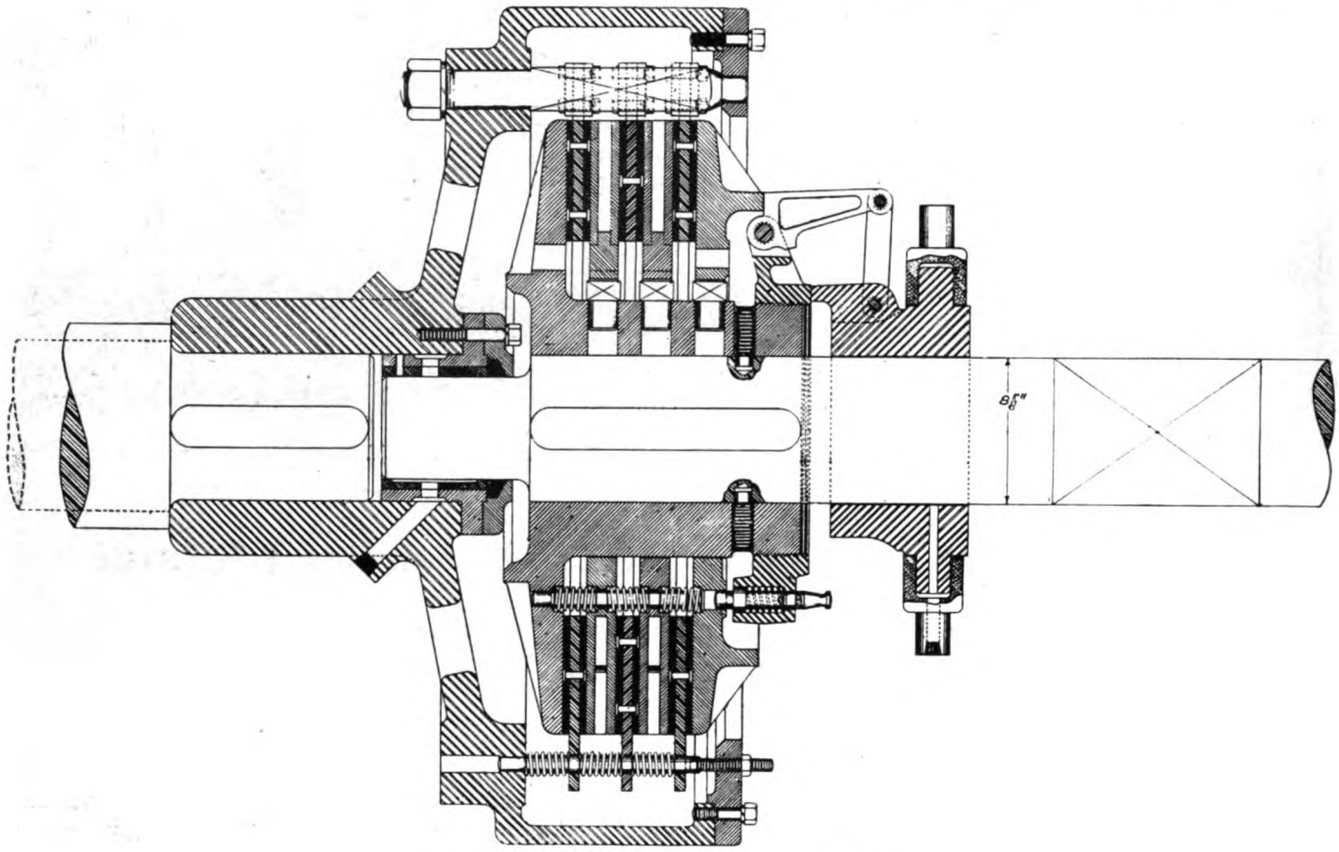
inches diameter by 22 feet long and each containing ten 6-inch flues. The boilers were built by the Fowler-Wolfe Sheet Metal Works of Paducah, Ky.



Section through clutch and driving spider

The auxiliaries include the following:

One Hegewald doctor, type "F," steam end 7½ feet by 15¾ inches, water end 5 inches by 11⅛ inches.
One Terry steam turbine, driving a 10-kilowatt generator.
Two sanitary and fresh water pumps each 4½ inches by 2¾ inches by 4 inches furnished by Vogt Brothers Manufacturing Company, Louisville, Ky.
Two Douglas hand pumps.
One 2 inch Metropolitan injector.
One Worthington duplex fire pump, 7½ inches by 4½ inches by 10 inches.

The steam steering gear, supplied by the S. J. Gardner Foundry & Machine Company of New Albany, Ind., is located underneath the main deck directly over the rudders. Cory type mechanical telegraphs are installed for communication between the engine room and pilot house.

Disk Clutch for Marine Service

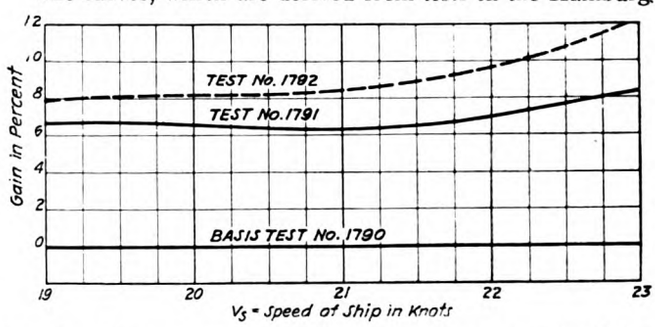
A NEW disk clutch, designed particularly for use in connection with marine engines, is being produced by the Twin Disc Clutch Company of Racine, Wis. The clutch illustrated was built for use on a double ended ferryboat, propelled by Diesel engines. It is designed to transmit 400 horsepower at 100 revolutions per minute but has a maximum capacity of 748 horsepower at 100 revolutions.

The Twin Disc Clutch Company has been manufacturing clutches of the same general type as that shown for a number of years, but of less capacity. These clutches are used in a wide range of industrial machinery including tractors, gasoline locomotives, cranes, machine tools and various types of heavy machinery, the maximum capacity heretofore having been approximately 108 horsepower at 100 revolutions per minute. The new clutch, designated as the F.-3-36, has been designed to meet a growing demand for larger powers and embodies the wide experience gained in the production of many thousands of the smaller sizes.

Reduction in Power Due to the Use of Guide Blades

THE material gain resulting from the application of contrapropellers to a large twin screw vessel is illustrated by the accompanying diagram.

The curves, which are derived from tests in the Hamburg tank of a self-propelled model of the Italian steamship *Conte Biancamano*, indicate the power saved by the use of two types of guide blades, the saving being given in percent of the original power required at the various speeds, when no guide blades were fitted.



Results of tests made at Hamburg Experimental Model Basin on model of S. S. Conte Biancamano with and without guide vanes

Test No. 1790, without guide vanes. Test No. 1791, with inboard guide vanes. Test No. 1792, with inboard and outboard guide vanes.

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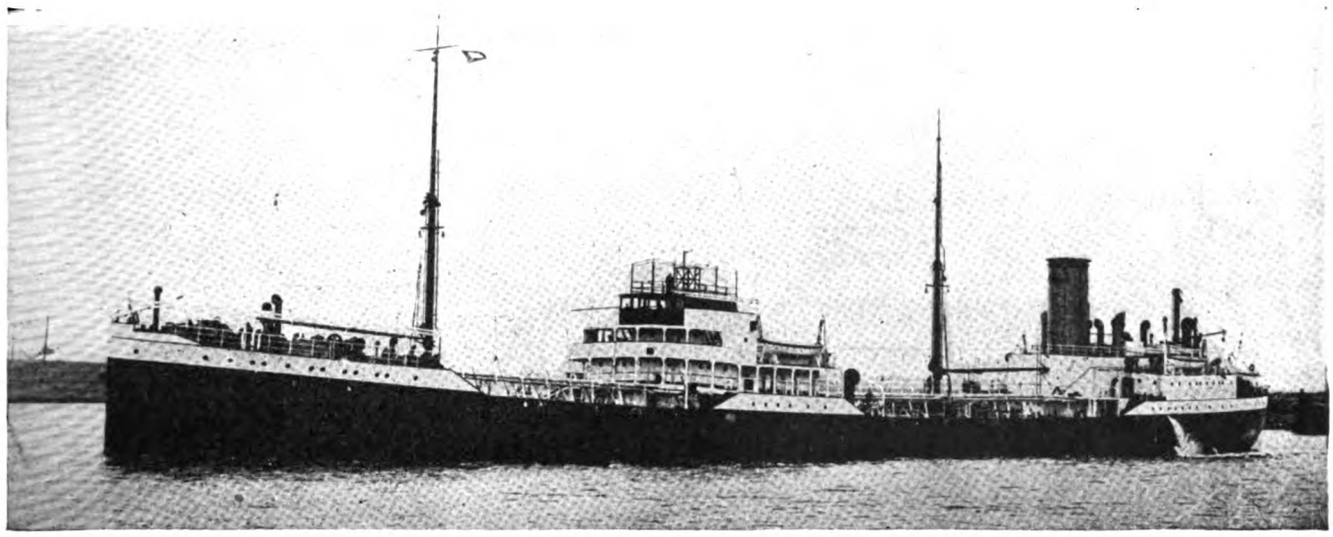

The Anglo Saxon Company's 10,000-ton motor tanker Phobos, the first of twelve similar vessels all to be delivered this year

New Ships With Double Acting Diesel Engines

The Stentor and Phobos, propelled by the novel type of Werkspoor four cycle motor

By Our Special London Correspondent

THERE is no doubt that the double acting Diesel engine is attracting increased attention, among both shipowners and marine engine builders in Europe, and there is a general belief, particularly in cases where powers of 4,000 shaft horsepower and upwards are required, that the double acting design will gradually, if not rapidly, become more popular. Opinion is divided on the question of the respective advantages of the four stroke and two stroke principles, perhaps with a bias towards the latter, but the fact remains that three of the most experienced manufacturers of marine oil engines have developed double acting four stroke machines, namely, Burmeister & Wain, Werkspoor and the Tosi Company.

Burmeister and Tosi double acting motors are already in service, and the first examples of the Werkspoor type are installed in two ships of entirely different class, which, by a coincidence, were both commissioned in the last few days of 1926. They are, respectively, the 10,000-ton tanker *Phobos,* built by the Netherland Shipbuilding Company for the Anglo Saxon Petroleum Company, and the 9,000-ton *Stentor,* a cargo liner which forms an addition to the already extensive fleet of motor vessels owned by Messrs. Alfred Holt & Company.

The Stentor

As is well known, the Holt (or the Blue Funnel) Line standardize their vessels to a certain extent, and the *Stentor* is no exception. She is similar, so far as hull dimensions are concerned, to many other Blue Funnel liners, being 425 feet in length between perpendiculars with a beam of 55 feet 6 inches and a draft when laden of 26 feet. The service speed is 13½ knots, and the vessel has been specially designed for carrying cargo and also native passengers in the Far East.

A feature of Blue Funnel ships is the number of winches invariably fitted and, in this case, there are 20, two capable of hoisting 8 tons and all electrically-driven. Incidentally, it may be recorded, without any shadow of doubt, that all shipowners in Europe who are taking to oil engine drive, are tending more and more towards the employment of electrically-operated auxiliaries, except in a few special instances. In the *Stentor* an arrangement is employed which differs from that used on most cargo motorships and four Diesel driven generators are installed in the engine room, each of 100 kilowatts capacity. It might be thought that three would be sufficient and this is the number generally fitted, but doubtless the owners have their own reason for departing from standard practice.

Turning to the propelling engine, built by the North Eastern Marine Engineering Company, which has been actively associated with the Werkspoor Company in the development of the double acting type, this unit is designed to develop 4,000 shaft horsepower and to give the vessel a service speed of 13½ knots. It has six cylinders 820 millimeters stroke with a piston stroke of 1,500 millimeters, dimensions which are practically identical with those of the standard Burmeister & Wain double acting engine. The full output is developed at 95 revolutions per minute. The novel principle is employed of using a lower compression pressure below the piston than that above, the respective figures being about 255 pounds per square inch and 425 pounds per square inch.

The engine is started up by admitting air through valves, only above the piston, and after firing occurs, the exhaust gases from the top are delivered to the lower combustion chamber and thence to the bottom part of the cylinder instead of being discharged to the exhaust pipe and silencer. The effect of this is to heat up the lower cylinder to that temperature which will permit of automatic ignition, which is not the case in the ordinary way since the compression pressure is too low.

As soon as temperature conditions are stabilized, however, ignition occurs regularly and the period of heating is actually only a minute or two. It follows from the differ-

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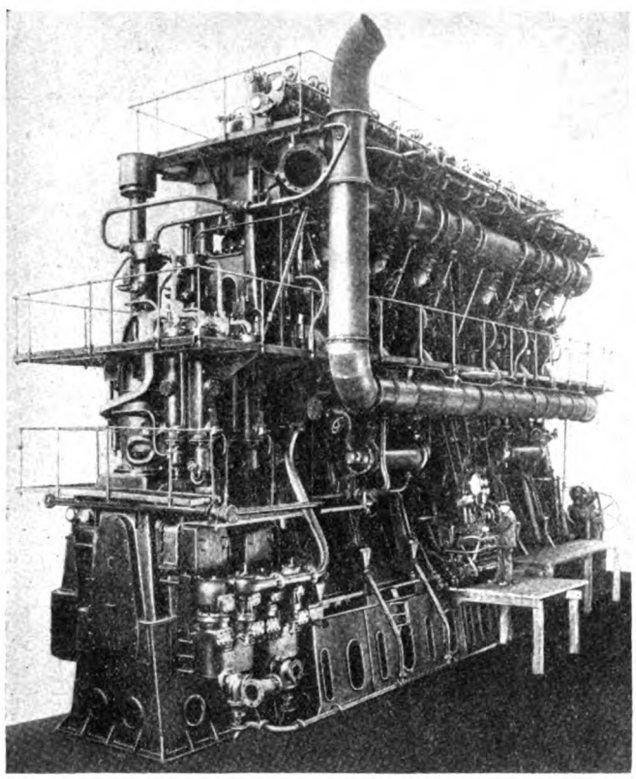
ence in compression pressures above and below the piston, that there are corresponding deviations in mean indicated pressures and also in power produced above and below the piston, exaggerated also by the piston rod. The result is that the brake horsepower produced below the piston is only about 60 percent of that above.

There is not much that calls for comment in the engine that has been outlined above. The valves at the top are normal and those at the bottom are enclosed in a combustion chamber formed by a separate casting bolted on to the cylinder. The control valves, top and bottom, are operated from a single cam shaft located at the level of the top of the engine so that the lower valves have to be actuated through short tappet rods in conjunction with the valve levers. Starting and maneuvering are effected in a



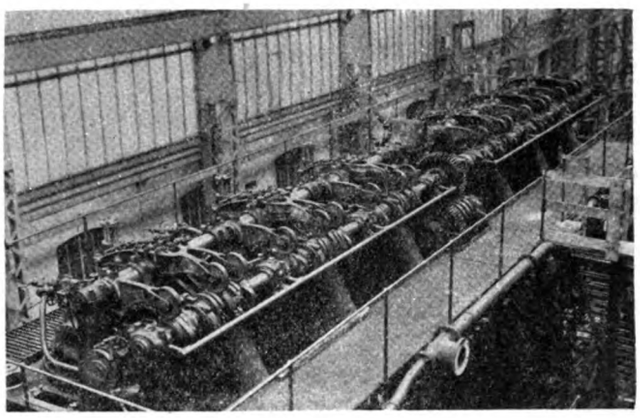
The Werkspoor double acting engine installed in the Phobos. It is the first engine of its type to be built

normal manner through servo motors, the cam shaft being moved fore and aft to bring astern cams in contact with the valve levers.

THE PHOBOS

Perhaps the most interesting feature of the motorship *Phobos,* which, as mentioned above, is also propelled by a four stroke double acting Werkspoor engine, is that she is the first of twelve exactly similar vessels built to the order of the Anglo Saxon Petroleum Company, all to be completed within the course of the next few months. When finished they will represent one of the largest fleets of entirely standardized motor craft in service, for not only are the hull dimensions and general arrangements similar but the propelling engine and the auxiliary plant are equally standardized.

Like several of the other big tanker owning companies, the Anglo Saxon Petroleum Company has embarked upon a policy of adding to an enormous extent to their existing fleet, and in almost all cases, Diesel engines are being specified. For instance, the British Tanker Company, Ltd.,

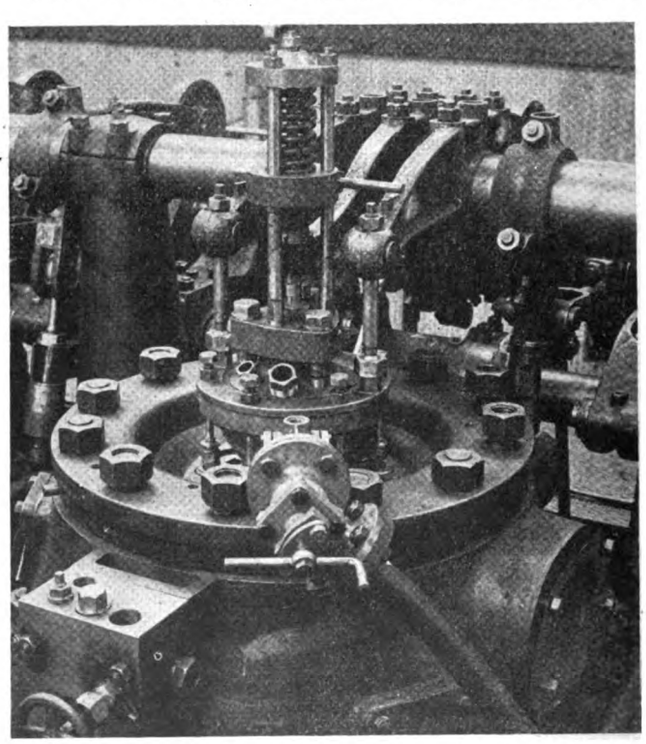


Top valve gear of the double acting Werkspoor engine installed in the Phobos

the carrying company of the Anglo Persian Oil Company, also has a dozen 10,000-ton motor tankers on order, but in these craft engines of various types are being installed, none of them of the double acting design. They include Sulzer, Burmeister & Wain and Doxford machinery, but the hulls are of similar dimensions, and, curiously enough, are almost identical with those of the Anglo Saxon Petroleum Company.

The *Phobos* is 440 feet in length with a beam of 59 feet and a depth of 32 feet 9 inches. Although the engine installed (built in this case by the Werkspoor Company) is of the same dimensions and general design as that in the *Stentor* an entire departure has been made in the upper cylinder covers. A tanker has a very short stay in port, so that time for overhaul is limited. With four cycle engines, periodical replacement of the exhaust valves is necessary and in order to avoid this or render it much simpler, the owners specified a different system from that normally employed.

Instead of having one large valve for the discharge of



Close-up view of one of the cylinder heads of the engine in the Phobos

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the exhaust gases and a similar valve for the admission of air, there is a series of six small valves arranged symmetrically and these serve alternately for exhaust and inlet. This involves the employment of a circular sleeve or director valve with suitable ports. It is operated from an eccentric on the cam shaft. It has twelve apertures, six leading to the exhaust belt and the other six to the inlet belt.

The motion of the sleeve alternately brings the exhaust belt and the inlet belt into communication with the cylinder. Thus the six small valves are kept clean by the passage of air over them every two revolutions, while, as they are very light, they can completely be removed if necessary and be replaced. On trials, the system has worked very satisfactorily. In most other respects the engine is identical to that installed in the *Stentor* and it may be noted that at the bottom of the cylinders, the ordinary large exhaust and inlet valves are used, as it is considered that the conditions in the lower portion of the cylinder are not so severe as in the upper portion. The weight of this engine is 520 tons, which is equivalent to 290 pounds per brake horsepower.

Todd Plant Gets Agwisun Contract

THE tanker *Agwisun*, sunk during an explosion in Brooklyn last year, was raised last month and towed to the Robins plant of the Todd Shipyards Corporation to whom the contract for the repairs has been awarded.

Survey of the vessel showed that the entire ship, from the amidships quarters to the boiler room casing aft, had been practically destroyed. The back of the vessel was broken and she was drawing 13 feet forward, 19 feet aft and 24 feet amidships. Temporary repairs had to be made before it was possible to move her.

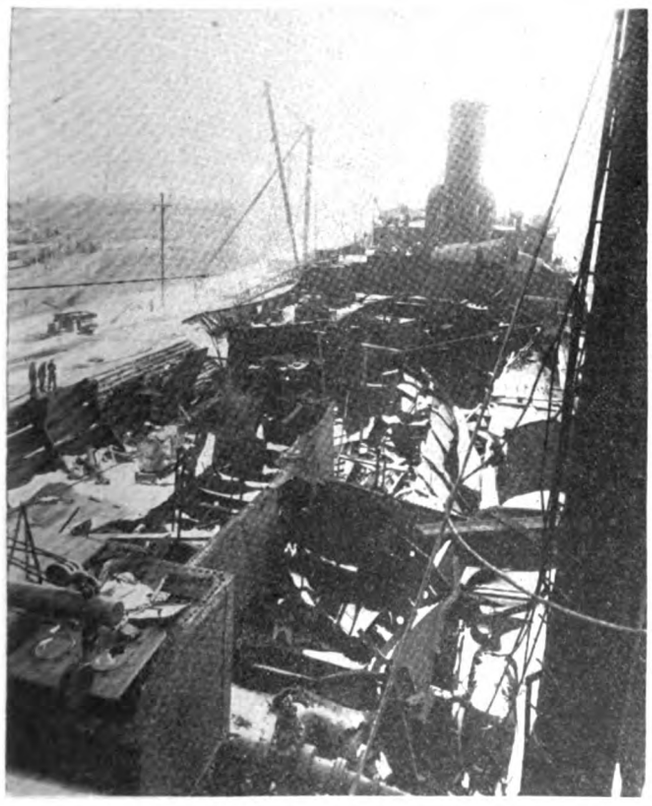
To float the vessel to a draft that would permit her to be dry docked was unusually difficult, as it was feared that,

The Agwisun in dry dock

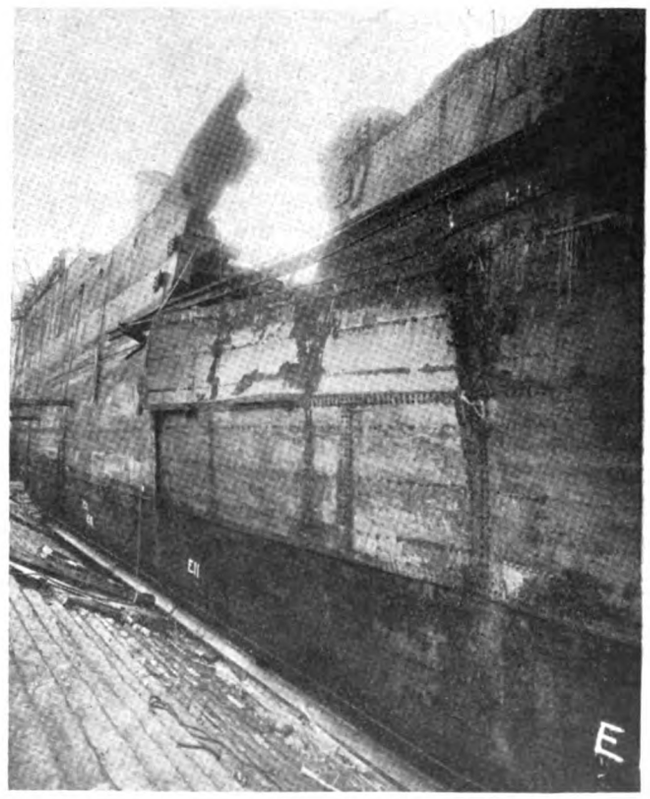
owing to her weakened midship section, should she be pumped out too far amidships she would crack and break the other way, dropping her stem and stern deep down and leaving the amidships section light. To prevent this, heavy steel hawsers were stretched from her forecastle head, over the bridge, to the poop deck and a heavy channel was secured on the starboard side across the break.

Huge gaps in the tanker's sides were covered with heavy rope mats and canvas wedged under steel wires that had been stretched for the purpose. These patches were necessarily flexible to permit the working of the ship as she was pumped out.

These precautions permitted the successful raising of the vessel to about a 16-foot depth and then a favorable tide was awaited to place the *Agwisun* in the graving dock. To insure her passing safely through the entrance of the dock, two large steel pontoons were placed under her after quar-



Looking aft from the forecastle showing havoc wrought by the explosion



Starboard side of the vessel, showing channel holding torn parts of the hull together

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ters, one one the port side and one on the starboard side. Each pontoon had a lifting power of 50 tons. Supplementing this, a floating derrick was alongside lifting on a sling that had been placed under the stern frame arch.

Cribwork was ready on the dry dock floor and the tanker settled down straight and true, ready for the skill of the ship surgeons that will make her ready for sea again in four months.

Cutting Metals Under Water*

By L. F. Hagglund†

BROADLY the cutting of metals under water resolves itself into two classes. First the class of work on which dynamite can be used. Second the work that must be done by a cutting tool that will not damage adjacent structures and that will cut along a prescribed line.

The former or dynamite jobs consist chiefly of the removal of wrecked steel vessels or isolated metallic submarine structures. For this work where dynamite can be used freely, it is by far the cheaper and most expeditious method. The removal of the wreck of the S.S. *Canadian Recruit* will serve to illustrate an application of the method. The *Canadian Recruit* sank in the St. Lawrence River about 50 miles below Quebec where the river is about 7 miles wide. The wreck was 2½ miles from shore but close to the river channel so that it was a menace to navigation and had to be removed. The Canadian Salvors undertook the work of removal. Accordingly with a small wrecking plant, two divers and a large quantity of dynamite they succeeded, during the past summer, in practically blowing the wreck to pieces and scattering these pieces so that the required depth of the water was obtained at that location. In this instance nothing was to be saved. The job was simply one of removal and dynamite did the work. But even for success with this method a diver experienced in the use of dynamite must be obtained and as there are but few divers and a very few who have had experience with explosives, getting the right man is important.

For metal that must be cut accurately under water there has been for years the hacksaw, chisel and drill spurred on by the right hand and arm of a diver or by compressed air. These tools sufficed until the period of the world war.

At that time 1914-1918 with the increased volume of shipping menaced by an ever increasing number of submarines, wrecks of steel vessels became numerous. Accordingly marine wrecking or salvage received an incentive in this volume of work to develop new and better methods. One need was that for a rapid and reliable under water metal cutting tool.

The oxy-acetylene torch had come into its own for cutting and welding metals above water and at first efforts were made to adapt this torch for work under water. Records and reports show that on several jobs fairly good results were obtained in limited depths. In practically all of these cases an ordinary oxy-acetylene torch was used together with some means or apparatus to displace the water from the immediate vicinity of the cutting flame and the metal where it was acting. The difficulties encountered were numerous, the surrounding water pressure, the increase in this hydrostatic pressure with depth. In sea water this amounts to approximately ½ pound per foot or about 45 pounds in 100 feet of water. Another difficulty is that at times it is actually impossible for the diver to see what he is doing and he must rely solely on his sense of touch. Aside from these things each job presents its own particular handicaps, a strong tide or river current, extreme cold, the presence of concrete or heavy paint on the metal, concrete in the interlock of steel piling or a short diving time in great depths—almost a new problem on every job.

The old Merritt & Chapman Derrick & Wrecking Company in New York understood the problem and looked at it from the diver's viewpoint. One of their men suggested the possibility of using a jet of oxygen upon metal heated by the electric arc under water. As a marine wrecking company they had a fairly constant though limited demand for such a tool and as a result of this suggestion, their own engineers and divers conducted experimental work along this line. They first believed that the heat of the arc alone could be used to cut metal under water. However, owing to the enormous quantity of water in contact with any submerged metal as in this case of a sunken hull, the heat generated by the arc at any one point was rapidly dissipated and the instant the arc was moved away, the molten metal solidified—usually solidifying in the cut reuniting the metal. This made it extremely difficult if not impossible to make a continuous cut under water with the arc alone.

To overcome this difficulty and achieve a continuous cut, a jet of oxygen was combined with the arc. A carbon electrode containing several gas tubes was used. Through these tubes oxygen under high pressure was forced directly on to the metal where the arc was drawn.

This combination of the electric arc with oxygen accomplished the desired results. It was possible to cut metal under water; to cut any metal under awter and at any divable depth. The depth of water does not affect the arc and an increase in depth simply means an increase in pressure at which the oxygen gas is supplied.

Subsequently during the salvage operations conducted on the S.S. *St. Paul* sunk in New York Harbor in 1918, Ralph E. Chapman and John W. Kirk took out a patent on a method for cutting metals under water. This method combines the heat of the arc with the oxidizing effect of a stream of oxygen under high pressure.

The under water metal cutting apparatus consists of a generating unit, switchboard and resistance, a supply of oxygen, oxygen gage and hose, and the double conductor hose through which both oxygen and electricity are carried to the torch. The torch itself consists of a carbon electrode 12 inches long clamped into a brass holder at one end. Extending through this electrode are two copper tubes. At one end these tubes are also clamped in the brass holder and at the other they terminate at the tip of the electrode.

When the diver strikes an arc under water with this torch, the oxygen is released through the arc and forced upon the molten metal. Cutting starts immediately and the speed possible depends upon the current available and the facility with which the diver can work. And the latter depends upon the job.

In one instance during the early part of this year a quantity of steel sheet piling was to be cut at a depth of 20 feet. When the diver was actually on the job it was found that even in 20 feet of water these steel piles were covered with 12 inches of ice along the desired line cut. This ice had formed when the river was low and remained on the piling when the water rose. It then became necessary to remove this ice before the piling could be reached.

In another instance where only 32 feet of ½-inch steel plate was to be cut, it was found that owing to the quantity of mud and silt in the river, the diver was unable to see the work he was doing or even the electric arc itself at any time during the entire operation.

To date steel plate, sheet piling, cast steel, cast iron, copper and brass have been cut 120 feet under water.

To meet a limited but important demand for under water metal cutting apparatus complete apparatus and skilled diver operators are carried on hand by the Merritt-Chapman & Scott Corporation and can be furnished on short notice for work anywhere in the United States.

* Paper presented at International Acetylene Association Convention, Chicago, November 12, 1926.

† Under-Water Metal Cutting Corporation, New York City.

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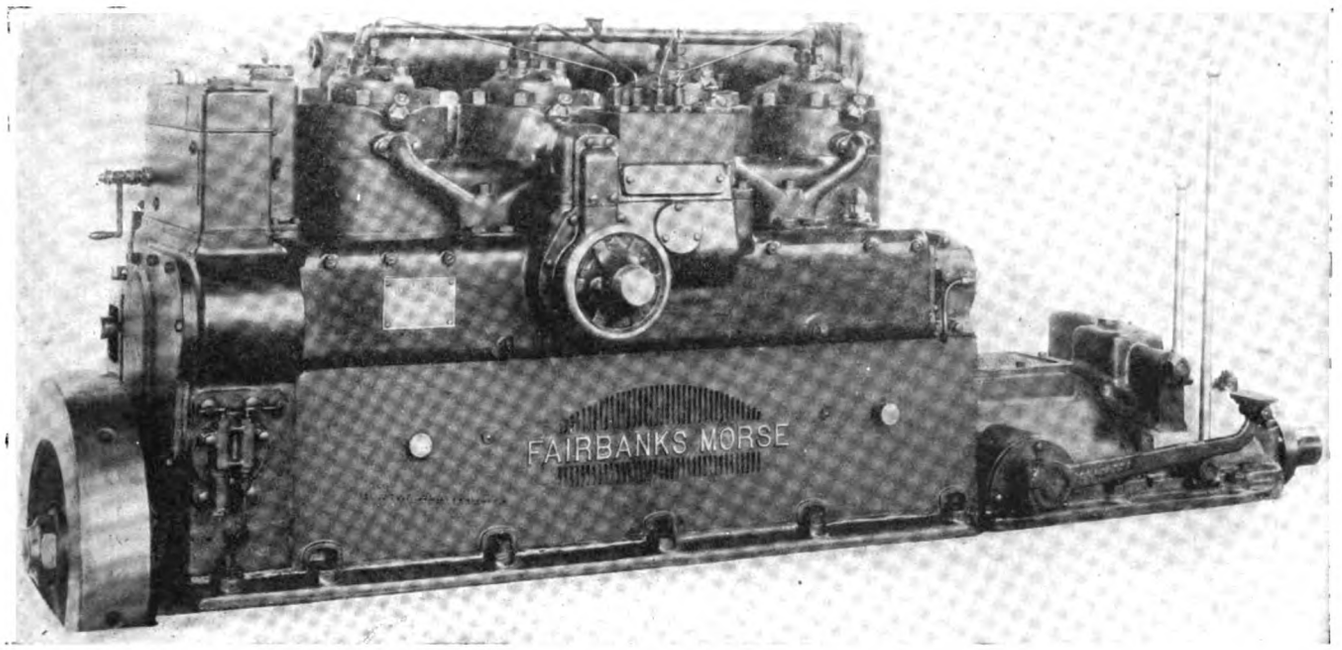


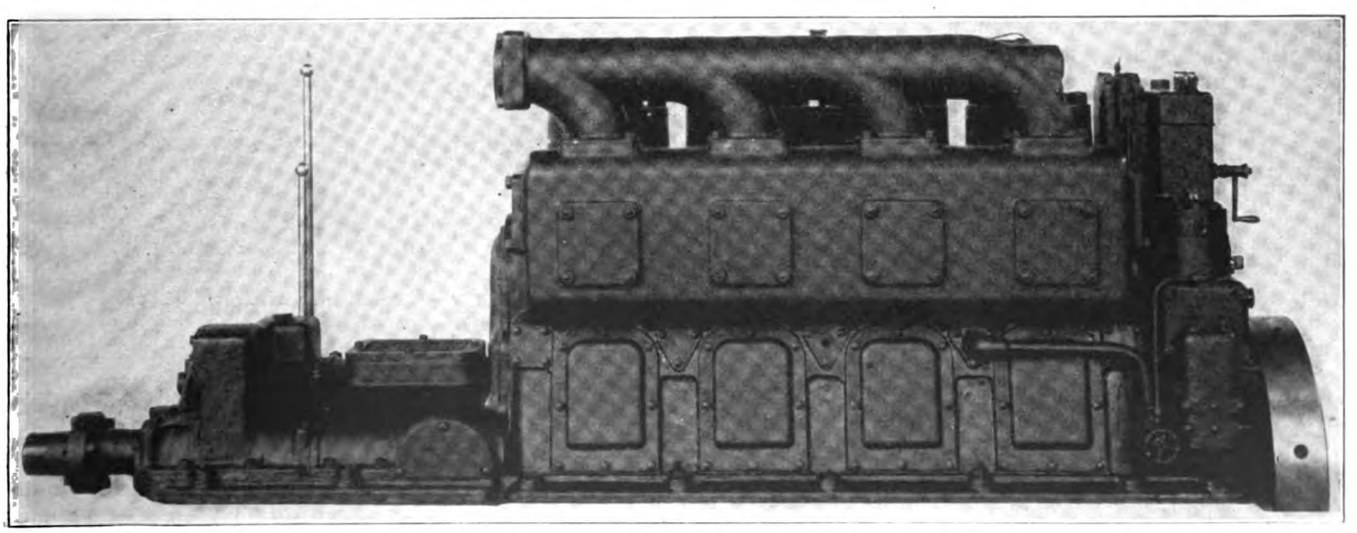
Operating side of 40 horsepower marine Diesel engine

Developments in Small Diesel Engines

New line of Fairbanks-Morse Diesel engines in 10 horsepower cylinder size shows trend in design— Small Diesels are now on par with large main units

IMPROVEMENTS in the design and construction of Diesel engines have been unusually rapid during the past few years. That this development has reached the small engine field is shown by the fact that Fairbanks-Morse has recently announced a line of Diesel engines in a 10 horsepower cylinder size operating at a speed of 650 revolutions per minute. This new line is to be built for direct drive for use in small vessels and also in Diesel generating sets for use as an auxiliary in connection with the main propulsion engines. The new engine is already available in the 2 and 4 cylinder sizes, which are rated at 20 and 40 horsepower, and in the generating sets which are rated at 18 and 36 kilowatts, and it is expected that the 30 horsepower unit and 27 kilowatt generating set will be brought through shortly. The generating sets operate at a speed of 800 revolutions per minute.

There is no question but what this new small Diesel is one of the most outstanding developments in Diesel engine engineering. It makes available for the first time the simplicity of the two cycle engine in small engines which have all of the refinements of the largest Diesel engines. Although the new engines follow in general principle the



Exhaust side of 40 horsepower marine Diesel engine, showing built-in circulating and bilge pump and the air compressor

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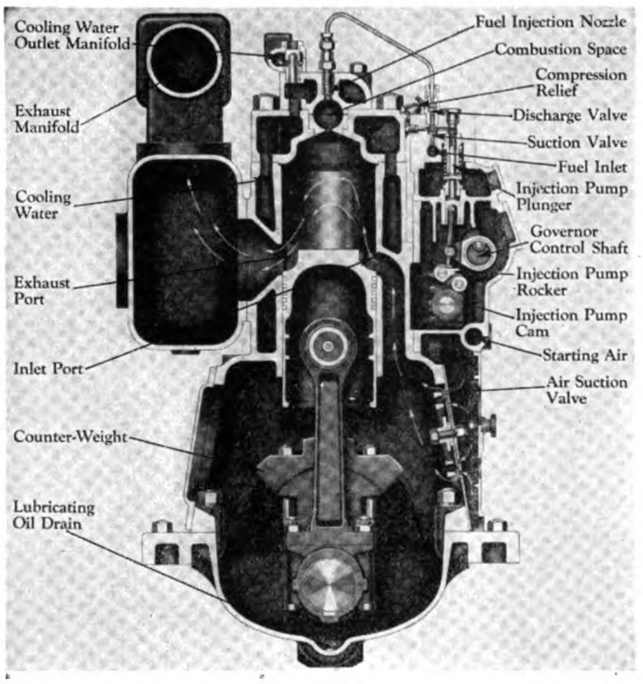
lines of the 60 to 360 horsepower series which are described in our February, 1926, issue, they have a number of interesting features. The exhaust header is applied in a very simple manner. It increases the rigidity of the entire assembly and at the same time reduces the weight in pounds per horsepower. In many cases small engines are set on foundations which are not rigid. This rigidity of the construction then becomes an important factor in maintaining bearing alinement.



Section through cylinder of 20 horsepower, two cycle, airless injection Diesel engine

Other important features of the engine include complete automatic lubrication, a simplified control which is arranged for both manual operation and for governor control and a built-in transmission. The lower base is of sturdy construction with heavy transverse bridges which form the main bearing supports. At the forward end of the lower base is a compartment which houses the gear which drives the lay shaft and the eccentric which drives the built-in air compressor and circulating and bilge pumps. This compartment also forms a sump for clean lubricating oil.

In arranging for the drive for the built-in compressor and circulating bilge pumps the designers have used a very ingenious arrangement. The eccentric actuates a rocker arm which in turn drives the piston of the compressor through a link connection. The piston rod of this compressor is extended so that it becomes the piston rod for the pump. This pump is double acting with two sets of valves, one side of the pump being used for circulating water and the other side as a bilge pump. This arrangement is a very simple one and is compact and yet accessible.

The shaft which carries the idler gear of the lay shaft train also carries an eccentric which drives two plunger lubricating oil pumps. One of these pumps takes its suction from the crank case compartment previously mentioned and pumps the oil under pressure to the lay shaft bearings and to such rockers, rollers and pins as go to make up the injection and governor pump drives and the compressor and pump drives. The other pump takes the oil from the individual crank case of each cylinder and pumps it to the filter. Since the oil used in engines of this rating is a comparatively small amount, the filtering can be handled in batches and the oil is poured back into the main lubricating sump or to the force-feed lubricator.

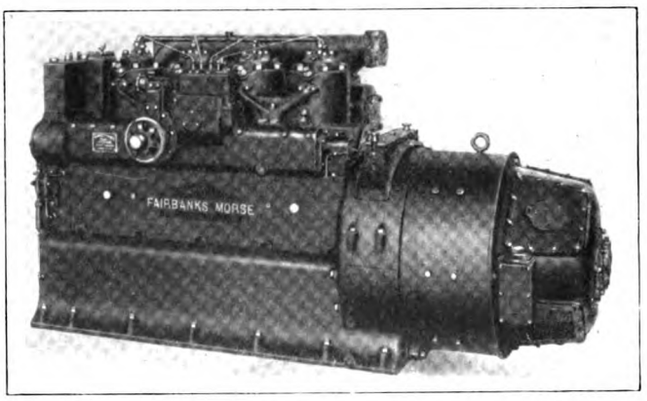
This force-feed lubricator lubricates the piston pin and the cylinders and also the crank pins and main bearings. It can be seen from this brief description, that every part of the engine is automatically lubricated.

To get a really good idea of the unusual flexibility of this engine one must see it in operation and actually manipulate the controls. The control is extremely simple and yet it functions so perfectly that the engine will throttle down to a very low speed and when the manual control is opened suddenly it comes up to speed in the same way that a high grade automobile engine speeds up when the throttle is suddenly opened.

The individual cams which operate the fuel pumps and the air starting valves are mounted on the lay shaft which is driven by the gear train previously mentioned. The governor is also driven by a worm gear from this lay shaft.

There is one important difference in the fuel injection scheme which is used with this line of engines as compared with that in other Fairbanks-Morse Diesels. The amount of fuel injected is controlled by the length of the injection pump plunger stroke and not by the closing of the suction valves. These valves are automatic in their operation, that is, they open and admit fuel to the barrel of the injection pump on the down stroke of the plunger. The stroke of the plunger is regulated through a very simple linkage arrangement. The governor control shaft, as shown in the accompanying transverse section of the engine, is pivoted eccentrically so that any movement of the governor weights tends to move the pump plunger push rod with respect to the cam operated rocker arm. The position of the push rod on this rocker determines the amount of fuel injected by the pump. When the push rod is moving over towards the pivoting point of the rocker the movement of the push rod approaches zero. The pump plunger, of course, is operated through a crosshead to which the push rod is connected. This system of control gives very fine gradations of the amount of fuel which is injected and the arrangement used is even simpler than where a suction valve must be controlled in order to measure the amount of fuel to be injected.

The fuel supplied to the suction valves is under a pressure of 5 pounds. This is obtained by having the gear pump which supplies the fuel to the auxiliary fuel reservoir on the engine operate against a spring loaded relief valve. In other words, when the fuel pressure builds up to the 5 pounds, the excess fuel which is pumped by the gear pump overflows back to the main supply tank. By having the fuel under pressure the cylinders of the injection pumps are positively filled on the opening of the suction valve and there is no possibility of the pumps be-



35-kilowatt Diesel engine generating set

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coming air bound or of not discharging the full amount of fuel called for by the particular governor setting.

There is no starting control wheel for this engine since it is built non-reversing and all that is required is a quick opening air valve in the air line to the pipe which leads to the starting valves. The governor setting is changed by means of a small hand wheel.

It requires several turns of the governor wheel to effect any substantial change in the speed of the engine and so a manual control is provided. There is a small knob on the upper left hand side of the governor housing. This works directly on the governor control shaft and, therefore, changes the setting of the injection pump plunger stroke to control the engine speed below that for which the governor is set, without changing the setting of the governor springs.

For most marine maneuvering service it is probable that the manual control will be used exclusively. When, however, it is necessary to operate the engine for any length of time at reduced speeds it is advisable to set the speed by means of the governor control wheel. The manual control is also used for shutting the engine down and for any quick changes of speed where the load remains reasonably constant.

Another important feature of the new line of marine Diesels is the use of a built-in automotive type transmission which gives two speeds forward and one reverse. With the transmission set for half speed operation and the engine turning over at half speed, the propeller turns at one-fourth full speed. At such a speed as this it would be possible to operate a fishing boat all day for trolling and still have the engine operate economically. Full power and full speed of the engine is used for reversing which is also another feature of the design.

This transmission is built with the same refinements that are used in building the engine and all gears are case hardened and every part is built to the highest specifications. In other words, it is not just a transmission which is added on to the engine as is the case in so many jobs of this type. Since the clutch is of the multiple disk type and there are no friction bands or small planetary gears in the transmission assembly, it is practically indestructible and may be operated for unlimited periods in reverse without overheating. This will be an important consideration from the standpoint of the user since there has sometimes been more trouble with transmissions and clutches than there has been with the engine itself.

As previously mentioned this line of engines will also be built as Diesel generating sets. One of these, the 4 cylinder 36-kilowatt, is shown in one of the accompanying illustrations. The engine is the same in all details with the exception that the bilge and circulating pumps are not used and the compressor may be operated unloaded except at such times as it is desired to fill the air starting tanks.

Trial Results of the S. S. King George V

THE results of the fuel consumption trials of the high pressure turbine steamer *King George V*, which was described in the October, 1926, issue of MARINE ENGINEERING AND SHIPPING AGE, are given in a paper on "Progress in Economy of Turbine Machinery on Land and Sea," presented before the North East Coast Institution of Engineers and Shipbuilders last month by Sir Charles A. Parsons, R. J. Walker and Stanley S. Cook. An abstract of this paper will be published in a later issue but owing to the widespread interest in the performance of this pioneer installation of high pressure machinery on board ship the trial results of the vessel, as given in this paper, are quoted below.

It will be recalled that the *King George V* develops 3,500 shaft horsepower on two shafts, the boiler pressure being 550 pounds per square inch with the steam superheated to 750 degrees F. The propelling machinery consists of a set of three turbines geared by single reduction to each propeller shaft, with one additional high pressure turbine fitted to utilize the expansion of the steam from 550 to about 200 pounds per square inch.

After the completion of the builder's trials, in which the specified speed and power were easily fulfilled, the *King George V* was put immediately on service on the Clyde, and ran regularly for three weeks to the end of the season. The vessel was then placed at the disposal of the builders for consumption trials. Calibrated measuring tanks were placed on deck, and connections made in such a way that a measurement could be taken both of the steam consumption of the turbines only and of the auxiliaries simultaneously.

Table I gives a record of the observed data at various powers.

TABLE I—TRIAL RESULTS T.S.S. *King George V*

Pressure at boilers—lb./sq. in. gage	520	543	502
Temp. at boilers	815° F.	785° F.	740° F.
Air pressure in stokehold, ins. w.g.	.765	.745	.43
Mean air temp. stokehold ° Fah.	110°	—	117°
Air temp. before heater ° Fah.	141°	—	127°
Air temp. after heater to grate ° Fah.	558°	526°	486°
Gas temp., base of funnel ° Fah.	616°	558°	523°
Mean revs. per minute	568.84	532.82	490.65
Total shaft horsepower	3489	2800	2083
Steam pressure H.P. turbine—lb./sq. in. gage	436	365	293
Steam temp. H.P. turbine ° Fah.	795°	755°	702°
Steam pressure 1st I. P. turbine	202	167	133
Steam temp. 1st I.P. turbine ° Fah.	678°	632°	578°
Steam pressure 2nd turbine	79.75	63.75	49.3
Steam temp. 2nd turbine ° Fah.	585°	543°	490°
Steam pressure L.P. turbine	6.88" V.	10.48" V.	14.27" V.
Steam temp. L.P. turbine ° Fah.	237°	226°	208°
L.P. exhaust vac. (30 bar.)	28.8"	28.95"	29.0"
L.P. exhaust temp.	87°	85°	81°
Condenser vac. (30 bar.)	29.04"	29.24"	29.08"
Temp. circulating inlet	49° F.	48°	49°
Temp. circulating discharge	69°	66°	66°
Circulating pump, revs./min.	362	354	303
Air pump, D.S./min.	33.6	34.86	28.7
Feed pump, D.S./min. P.	13.4	11.5	8.7
Feed pump, D.S./min. S.	7.7	7.2	6.5
Forced lub. pump, D.S./min. F.	25.6	21.0	22.9
Forced lub. pump, D.S./min. A.	8.6	5.9	6.3
F.D. fan engine, revs./min.	397	—	334
Dynamo, volts-amps	110-100	110-101	110-102
Mean temp. of engine room	90°	91°	87°
L.P. feed heater discharge	212°	—	212°
Water Consumption.			
Turbines, lbs./s.h.p./hour	8.01	8.38	8.72
Auxiliaries, lbs./s.h.p./hour	1.66	1.86	2.21
All purposes, lbs./s.h.p./hour	9.67	10.24	10.93
Coal consumption, lb./s.h.p. hour	1.085	—	1.17
Boiler efficiency	79%	—	80%

The coal used in these trials was ordinary Scotch "Polmaise," as used for service of these vessels. Its gross calorific value was determined as 13,880 B.T.U. per lb.

It should be observed that these figures agree closely with the results anticipated for this vessel, bearing in mind the small power per shaft and the shortness of the blades of the high pressure and first intermediate turbines, and confirm that in larger powers the gain of efficiency claimed for higher pressures and temperatures will be obtained. Further, the experiment has shown that there are no difficulties in the way of such installations which cannot be met by suitable provision.

FOREIGN TRADE LEADERS TO MEET IN DETROIT.—The fourteenth national foreign trade convention will be held in Detroit, Mich., on May 25, 26 and 27, according to an announcement made by James A. Farrell, chairman of the National Foreign Trade Council. "The past year has been an encouraging period of American foreign trade advance," Mr. Farrell states, for in it, "our share in the vast international trade of the world reached its highest point, whether measured by value or volume." The Detroit convention, in the midst of one of the most successful and powerful business communities in the country, will afford an opportunity for thoughtful examination of the present condition and future possibilities of our foreign trade.

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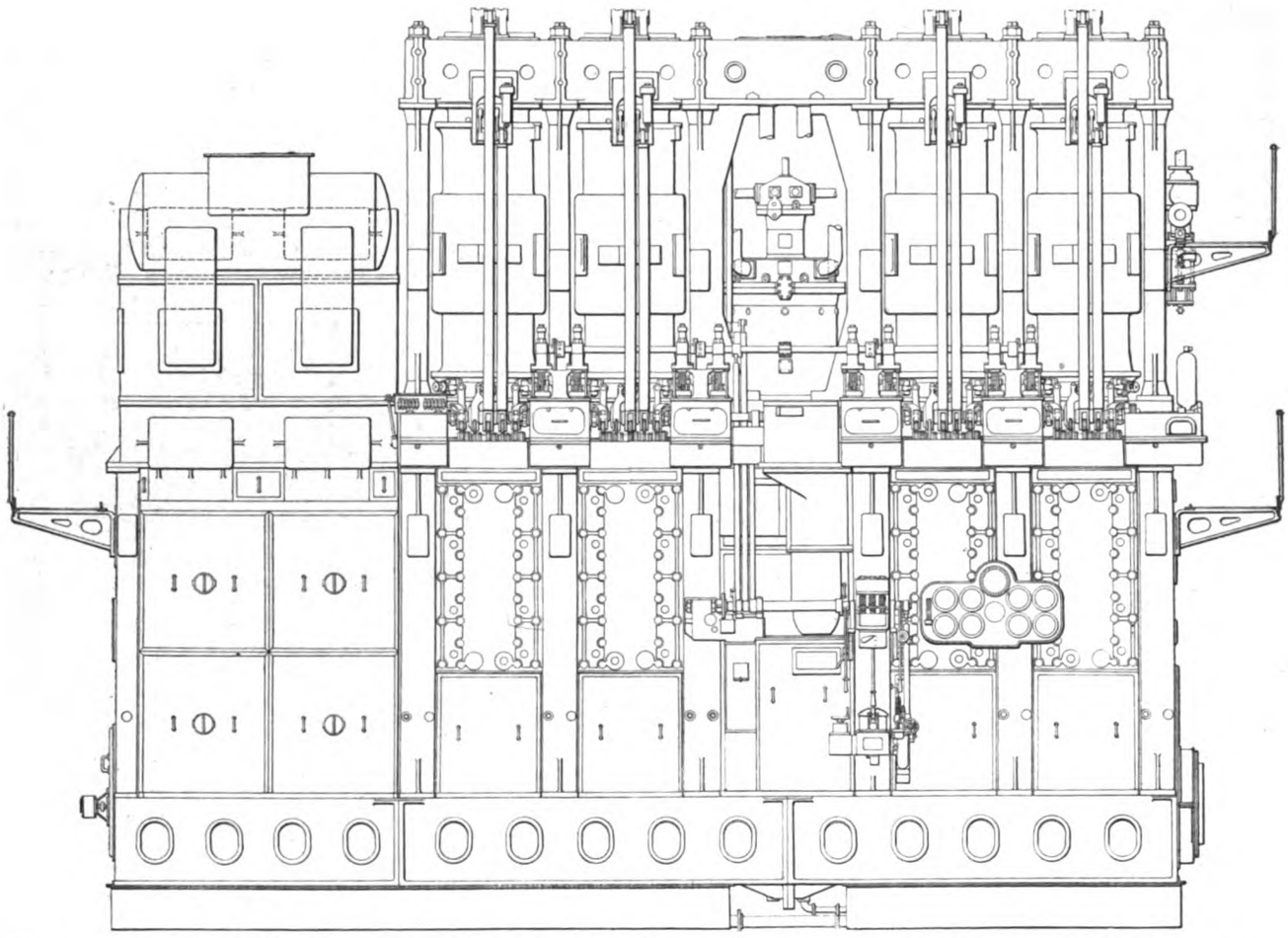

Side elevation of 3,300 horsepower Hamilton-M. A. N. engine. The scavenging pumps are at the end, the air compressor is at the center

The Hamilton-M. A. N. Marine Diesel Engine

Four cylinder, double acting, two cycle engine of 3,300 horsepower built for the Shipping Board

As a part of the Shipping Board Diesel conversion program, The Hooven, Owens, Rentschler Company, Hamilton, O., has just completed a double acting, two cycle, Hamilton-M.A.N. Diesel engine to be installed in the 9,600-ton cargo ship *Seminole*. The engine will develop 3,300 horsepower at 95 revolutions per minute. This power, however, can be increased to 4,500 by running the engine at maximum speed.

The diameter of the cylinders is 27½ inches and the stroke 47¼ inches. The engine has four cylinders and, in addition, there is driven direct from the crank shaft a three-stage compressor for air injection and a twin scavenging pump for scavenging the exhaust from the main cylinders.

The engine operates under air injection and has one fuel valve located in the upper cylinder head and four fuel valves located in the lower cylinder head. In addition, there are starting valves both on the top and on the bottom, and relief valves.

The engine operates on the patented M.A.N. system of scavenging. Each liner has two sets of ports on the same side, one directly above the other. The lower ports are the scavenging ports and the air is blown in across the top of the piston and forced to the top of the cylinder, then exhausted through the exhaust ports directly above the scavenging ports. This system has been thoroughly tested and has proven efficient not only in the preliminary investigation but in engines already in actual operation. The angles of the ports directing the air are carefully made so as to be able to bring the air current to every part of the cylinder.

Details of Construction

The construction of the engine is made up of a bed plate with wide and deep sections. Directly on top of the bed plate are the housings which are bolted to the top of the lower entablature which is of a heavy, cast iron section and extends the entire length of the engine. To the upper face of these entablatures are set the cylinder columns which again tie into the upper entablatures. The upper entablature is of similar construction to the lower, of a deep section and goes the entire length fore and aft of the engine. In addition to all these joints being held by bolts, there are also 4 tie bolts for each cylinder which extend from the bottom of the bed plate to the upper part of the upper entablatures.

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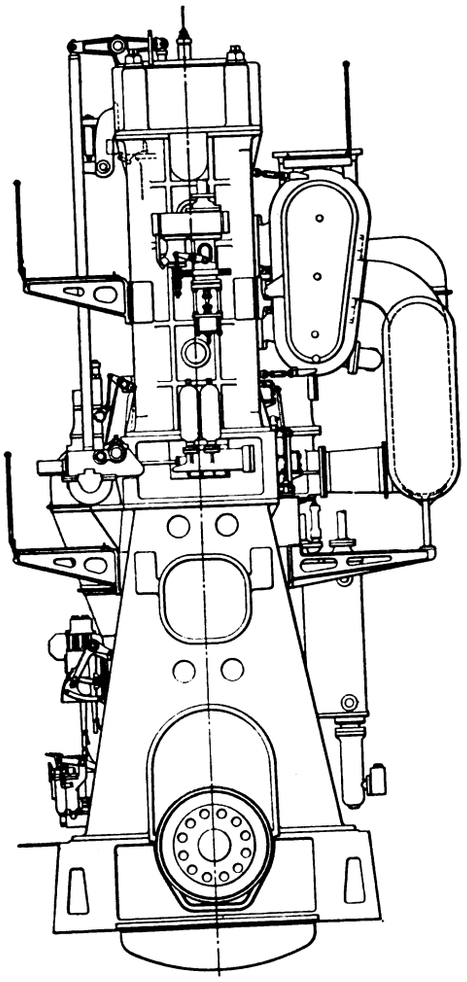
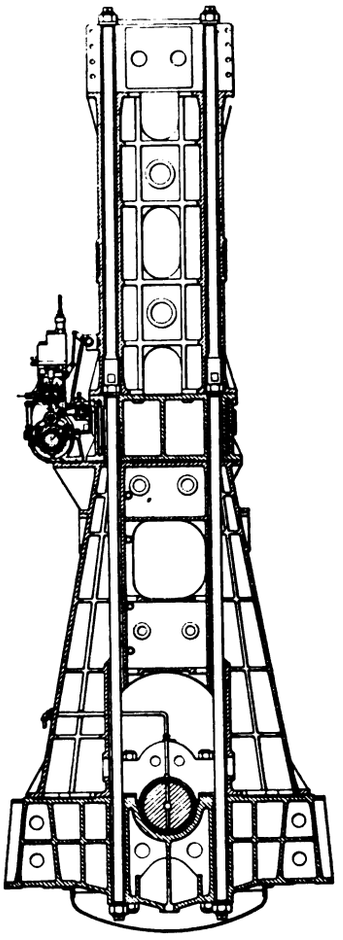
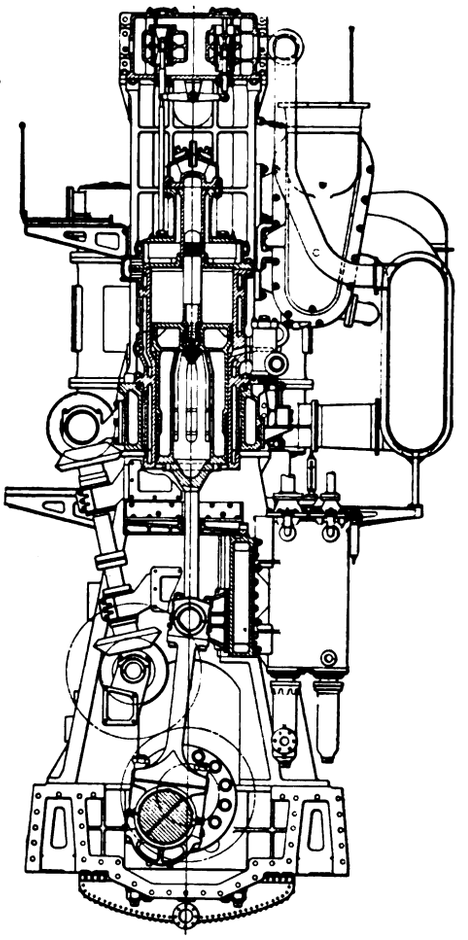


End elevation



Transverse section between cylinders, showing holding-down bolts

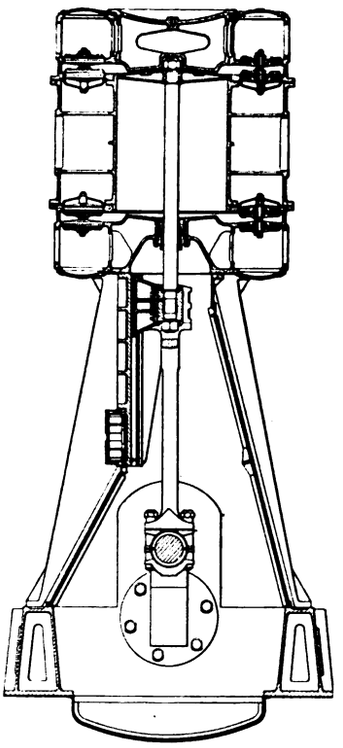


Transverse section through air compressor

The cylinders and cylinder jackets are set in between the columns, and inside of the cylinder jackets are liners made in halves—one for the upper and one for the lower. To the lower entablatures is bolted the cylinder jacket and to the upper entablatures is bolted the upper cylinder liner. The cylinder liners are so arranged that there is an opening in the center giving freedom of expansion. The cylinder jacket is held to the upper line by a stuffing box, giving it also freedom of expansion and contraction. The idea of the entire construction is to make a solid structural design in which all the tensile stress is absorbed by the tie rods and by tying the various members both athwartship and fore and aft gives the entire engine a rigidity which eliminates weaving or vibration and a freedom of expansion to the liners and cylinder jackets which are subjected to the heat of combustion.

AIR COMPRESSOR AND SCAVENGING PUMPS

The air compressor is of the conventional three-stage type driven from the crank shaft, through connecting rod and guide with crosshead. The pistons are of the step design with the high pressure on top, the low pressure in the middle and the intermediate at the lower end. The air is cooled between the stages through coolers which are provided with water separators so as to draw off the moisture from the air between each stage.



Transverse section through scavenging pump

The scavenging pumps are of the double acting type with plate valves especially designed for low air pressure. They are driven through crossheads direct from the shafts.

VALVES

The fuel and starting valves, for both the upper and lower cylinders, are driven from the cam shaft located in the middle of the engine, fastened to the lower entablature. The cam shaft receives its motion from the main shaft through a set of spur gears and bevel gears.

Reversing is accomplished by moving the cam shaft longitudinally and a complete extra set of cams is provided on the cam shaft for the astern motion. The cam shaft is moved by means of a ram operated by compressed air.

FUEL PUMPS

The fuel pumps are located on brackets directly above the cam shaft and are driven from cams on the cam shaft. This feature is novel and gives a timing to the fuel pumps which makes possible a closer

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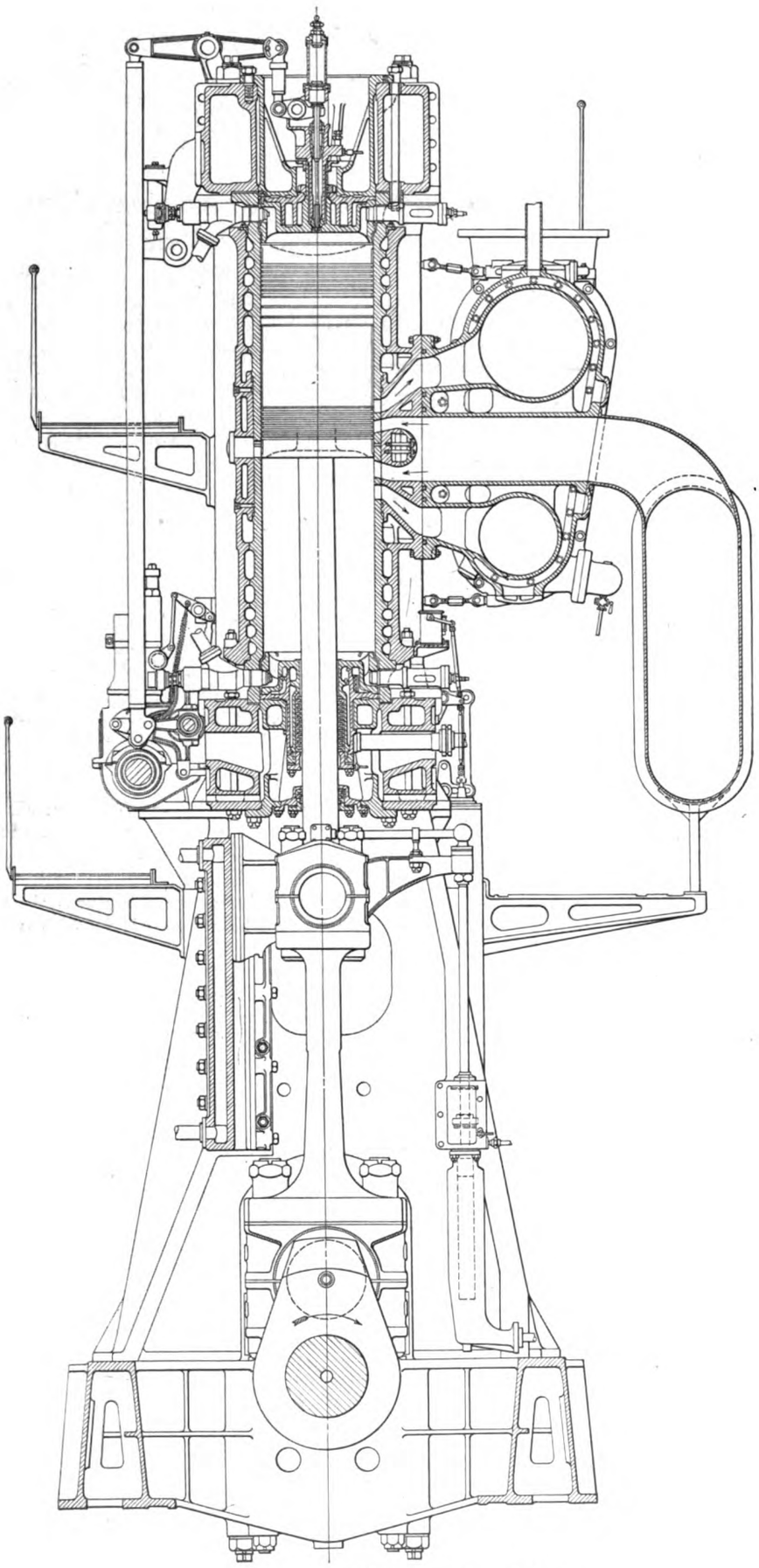
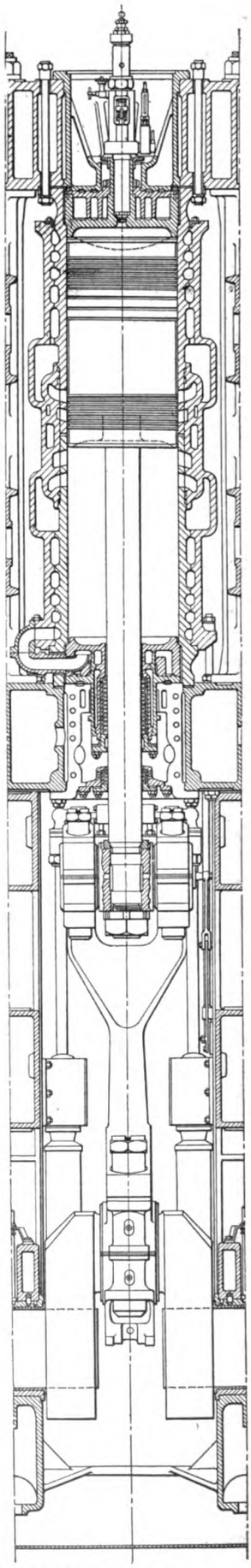


Transverse section through cylinder



Longitudinal section through cylinder

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regulation of the engine. There is one fuel plunger for each upper and lower cylinder.

OPERATING GEAR

The operating gear for the engine is located on the lower platform and consists of one lever which completely operates the engine for starting, reversing and stopping. The operation is carried by means of high pressure air to the main starting valve and reversing engine. In addition, there are located on the operating platform, one lever for regulating the amount of fuel and also one lever for operating the amount of air for the air compressor. The injection air pressure is controlled by a small hand wheel.

The engine is provided with an over-speed governor of the Aspinall type. The regulation of the engine is accomplished by by-passing the discharge valves on the fuel pump. The starting valves are automatically cut out as soon as the engine gets sufficient compression for igniting the fuel.

LUBRICATION AND COOLING

The entire engine is enclosed and subject to forced lubrication and a complete system of water cooling so as to give the proper circuit and speed of water where rapid extraction of heat is required.

The piston is cored out and the piston rod is hollow for circulating the cooling water to the pistons. The inlet and outlet of the water is through telescopic piping driven from the crosshead of the engine and working through stuffing boxes into air chambers so as to absolutely seal the water from getting into contact with the lubricating oil.

The crank shaft is of the built-up type. The connecting rod is of the conventional marine design. The crosshead is attached to the slipper which operates on the guide; this guide is of the single slipper type.

The main bearings are made with round valves and shims provided for adjustment in all parts subject to wear.

The materials used in the engine are cast iron for the structural parts; the liners are made of special cast iron of proper hardness for resisting wear. The cylinder heads are made of cast steel and in parts so as to provide proper water circulation. The piston heads are also of steel castings and constructed so as to be of great strength with proper openings for water circulation to transmit the heat rapidly.

The engine, including scavenging pump and compressor, weighs approximately 850,000 pounds. The length of the engine is 40 feet, the width 15 feet and the height 28 feet above the center of the shaft.

The engine is now subject to preliminary testing in the shops of the Hooven, Owens, Rentschler Company and will shortly be subjected to the thirty-day acceptance non-stop test required by the Shipping Board.

M.A.N. ENGINES BUILT ABROAD

Although the first engine of this design was completed only a year ago, there are already under construction in this country and abroad, engines of this type aggregating 77,000 brake horsepower. Included in this program is the *Augustus*, which will be the largest motorship in the world, recently launched in Italy, equipped with four 6-cylinder M.A.N. main engines each of 7,000 brake horsepower. These engines are identical in cylinder size and detail design to the engine just completed in Hamilton.

The most notable example is the 15,000 horsepower engine installed in the Hamburg Electric Light Station, Hamburg, Germany. This engine is in design exactly the same as the one the Hooven, Owens, Rentschler Company has built except that the cylinders are 34 inches diameter by 60 inches stroke and the engine consists of nine cylinders with attached compressors but with separate scavenging pumps. This engine was recently subjected to fuel tests and at full load the fuel consumption per brake horsepower was 0.372 pound, excluding the scavenging blower. It was found to be 0.394 pound per brake horsepower including the scavenging blower. The thermal efficiency, referred to brake horsepower was found to be 37.5 percent excluding the scavenging blower, or 35.7 percent including the blower. The engine has been in satisfactory operation for the past seven months.

Annual Meeting of American Marine Standards Committee

THE fourth annual meeting of the American Marine Standards Committee, which was held at the Department of Commerce, Washington, D. C., on January 17 and 18, consisted of a mass meeting of the membership of the committee on the 17th and the annual meeting of the executive board on the 18th. Colonel E. A. Simmons, chairman of the executive board, presided at both meetings.

At the mass meeting Colonel Simmons briefly reviewed the progress of the work of the committee, stating that during the past year more progress had been made than in all the previous years put together. Twenty-six new standards were approved in 1926 as against 4 during the previous year. The completion of the work in progress but unfinished during the year is estimated as follows: Hull details, 52.1 percent; engineering details, 59.3 percent; ship operation details 48 percent. The membership of the committee comprises 319 associate member bodies.

During the meeting, Honorable Herbert Hoover, secretary of Commerce, reviewed the work of the department of Commerce in preparing standard practices in industries. He stated that he had no faith in attempting to fix standards by law. Standards evolved by common agreement in the industries give assurance that they will be used.

At the annual meeting of the executive board the officers were re-elected as follows: Chairman, Colonel E. A. Simmons; vice president, Captain R. D. Gatewood; secretary, A. V. Bouillon.

The following were elected members of the Executive Board of the American Marine Standards Committee for the year 1927:

J. L. Ackerson, president and general manager, Merritt-Chapman & Scott Corporation, New York.

Rear Admiral J. D. Beuret, U. S. N., chief of Bureau of Construction and Repair, Navy Department, Washington, D. C.

H. L. Ferguson, president and general manager, Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

T. E. Ferris, naval architect and marine engineer, New York.

H. P. Frear, naval architect (retired), 7 East Market street, Bethlehem, Pa.

Captain R. D. Gatewood, U. S. N., manager, Maintenance and Repair Division, Emergency Fleet Corporation, New York.

W. F. Gibbs, president, Gibbs Brothers, Inc., New York.

Rear Admiral J. Halligan, Jr., U. S. N., chief of Bureau of Engineering, Navy Department, Washington, D. C.

D. N. Hoover, supervising inspector general, U. S. Steamboat Inspection Service, Department of Commerce, Washington, D. C.

Major General Edgar Jadwin, chief of engineers, U. S. A., War Department, Washington, D. C.

C. S. King, secretary, Atlantic Coast Shipbuilders Association, Philadelphia, Pa.

Captain C. A. McAllister, president, American Bureau of Shipping, New York.

S. D. McComb, manager, Marine Office of America, New York.

Captain J. F. Milliken, secretary, Neptune Association, New York.

R. W. Morrell, consulting naval architect, marine engineer and surveyor, New York.

F. C. Munson, president, Munson Steamship Line, New York.

E. H. Rigg, naval architect, American Brown Boveri Electric Corporation, Camden, N. J.

Dr. H. C. Sadler, University of Michigan, Ann Arbor, Mich.

G. C. Sharp, naval architect, engineer and marine surveyor, New York.

Colonel E. A. Simmons, president, Simmons-Boardman Publishing Company, New York.

J. J. Tynan, general manager, Union Plant, Bethlehem Shipbuilding Corporation, San Francisco, Cal.

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Corrosion*

With special reference to shell rivets and plates

By W. Bennett, B. Sc.†

SINCE the introduction of iron over a century ago, as a material for shipbuilding, and its later development in the form of steel, the subject of corrosion has become of increasing importance. A conservative estimate of the depreciation in the value of steel ships due to simple corrosion is probably from 1½ to 2½ percent per annum. While this wastage may be considered as a natural process which cannot be absolutely stopped, it is the business of the shipbuilder and engineer to use such means as will retard the phenomenon as much as possible and certain phases of accelerated corrosion in ships are sufficiently serious to warrant some attention at this time.

It is probably axiomatic that the two most important factors to a shipowner as affecting the strength and endurance of a steel vessel are the problems of its obsolescence and its deterioration. The one has to be reckoned with but cannot be avoided, while the other must also be reckoned with, and can be prevented.

The subject of deterioration, or the perhaps more characteristic term, "corrosion" of steel, is a very old one, but has too often been either neglected or forgotten altogether.

The term "corrosion" includes many diseases to which metals are exposed, and to intelligently render advice as to the prevention or cure of the trouble requires some understanding as to the cause. This can only be done after careful study and investigation.

The difficulty of the subject commences at this point, for, although a vast amount of experimental work and theorizing along certain lines has been carried out, it is only within recent years that the theoretical aspect of the subject has become more or less firmly established.

A digest of the theories will be given later, but before doing so it may be of interest to state at the outset a phase of the trouble which has recently come under observation, with which this paper is intended specially to deal.

The pitting and general corrosion of shell plating (particularly in oil tankers) is, fortunately, not as common in American vessels as in others, but the phenomenon has recently come under consideration here in a somewhat different and perhaps more perplexing manner, and for this reason this aspect will be considered first.

Some Recent Examples of Corrosion on Shell Rivet Points

Many vessels have lately been drydocked and repairs made to the under-water riveting (not including ordinary cases of damage repairs), due in some cases to slack rivets, and in others to corroded rivet points. This condition has been specially noticeable in some oil tankers in the coastwise service, although it has also been found in some freighters and in a few transatlantic oil tankers. The condition does not seem to be confined to vessels built in the same locality, nor at the same time, although most of the worst cases seem to have been built towards the end of the war period.

In order to depict the conditions found, the cases indicated in the following list may be cited:

An oil tanker of about 10,000 gross tons, built in 1918, came on drydock in 1925. Approximately 113,000 rivets (steel) were cut out and renewed, and, in addition, about 2,000 were re-calked. The vessel had been drydocked nine months previously. Several shell plates were renewed on account of wasted butts and seams. The vessel had been trading to shoal water ports, and it was stated she had not been drydocked for cleaning and recoating for more than a year after the completion of her construction.

A freighter of about 6,000 gross tons, built in 1920, came on drydock in 1925. Approximately 108,000 rivets were renewed in the landing edges of the keel plates, in the bottom plating generally, on the sides from upper bilge to "H" strake, and higher than this, in way of the oil fuel tanks. Nearly all of these rivets were renewed on account of general wastage and corrosion. One year had elapsed since the previous drydocking. The bottom appeared bare of paint, and slight pitting was observed generally over the bottom and sides. It was stated that she had not been drydocked for recoating of the bottom for a period of eighteen months after she was built.

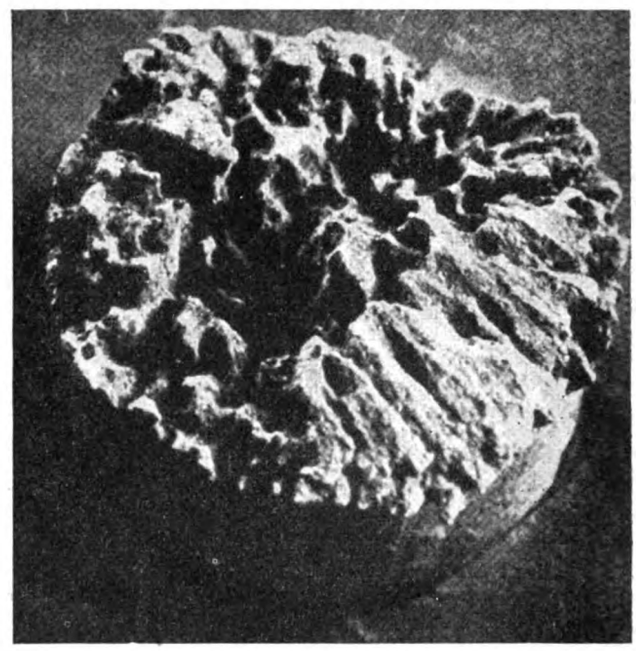

Fig. 1.—Corroded steel rivet point

An oil tanker of about 5,500 tons gross, built in 1917, came on drydock in 1924. Approximately 103,000 rivets in the keel to "E" strake, principally in the butts, but also in the seams and longitudinals, were renewed (i.e., nearly all the bottom shell rivets). Eight months had elapsed since the previous drydocking. The vessel had been trading to shoal water ports.

I have looked up a list of similar cases to those quoted, and out of forty-eight cases of vessels in which this type of bottom, rivet corrosion had been found, over one and one-half million rivets had been renewed, i.e., about 30,000 per vessel. Further, taking ten recent bad cases, I find an average of 80,000 rivets per ship renewed. Included in this are two cases in which approximately 200,000 rivets

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per ship have been renewed. Granted some of these renewals were made in order to render the re-riveting work continuous, yet if the rivets had not become slack and wasted, the others would not require to have been renewed.

These examples will serve as typical of many more that could be mentioned, and will show the nature of the trouble. In citing these cases it is not the intention to unnecessarily alarm shipowners and others with prospects of big repair bills, but by inviting criticism we may be enabled to know along what lines others view this very unsatisfactory condition which has recently developed, and possibly help in suggesting a prevention, if not a cure. On the other hand, it is hoped that at least this contribution will help to emphasize the need for a more careful selection of materials, efficient inspection and workmanship during construction, and the exercise of reasonable care in the vessel's subsequent upkeep and repair.

It will be observed from the foregoing list, that the majority of the renewals have been occasioned due to wastage and corrosion of the rivet points. Many of these rivet points, on being cleaned off, showed the rivets wasted to one-eight inch below the surface of the plating, and as much as one-quarter inch has been found in some cases. The point of the rivet on close examination has shown a honeycomb appearance (see Fig. 1). In some cases the tip of a knife blade could be inserted all around the rivet point. It should be noted that, in practically all the cases quoted, the affected rivets were of steel.

Fig. 2 shows a typically corroded iron rivet taken from the bottom of a vessel trading to gulf ports. The difference between the kind of corrosion found on the points of steel and iron rivets will be observed by comparing Figs. 1 and 2.

In some of the cases of corroded rivet points given above, it has been found that the heads were also affected. This is shown in Fig. 3 from which it will be seen that in one case the head is entirely gone, while in the other case it is partly wasted.

Explanations Advanced

In seeking an explanation as to the cause or causes that would account for the foregoing rather serious condition, the difficulty of providing a satisfactory explanation becomes apparent. Various suggestions have been advanced, such as

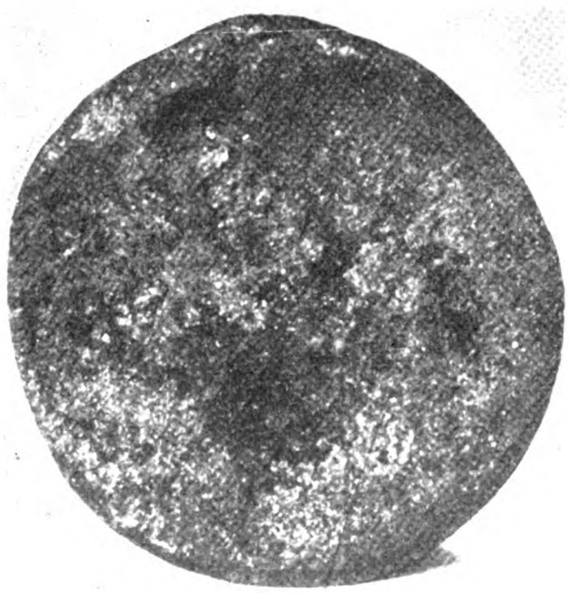

Fig. 2.—Corroded iron rivet point

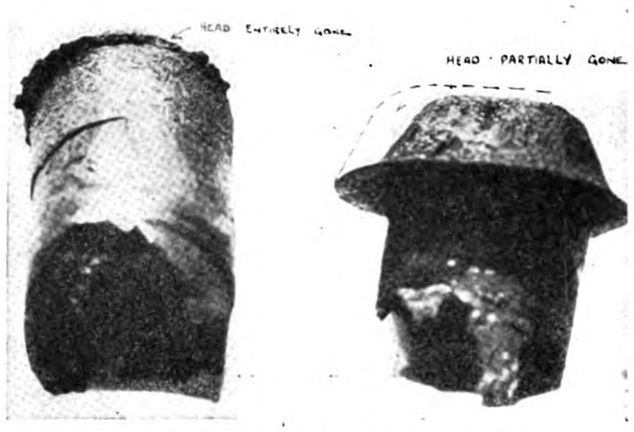

Fig. 3.—Corroded steel rivet head

the rubbing of the vessel's shell on the bottom at certain of the shoal water ports mentioned. So severe is this scoring action in certain cases that some of the bottom plates have had to be renewed. In one particular case the keel and adjacent strakes were renewed for practically the whole length of the ship. These had iron rivets, but none were found scored or corroded below the level of the plate.

The chemical action due to impurities, such as those coming from chemical works, fertilizing plants, oil plants, etc., has been blamed. It is a common custom to allow sewage to drain into canals and rivers, and it is thought by some that this practice may increase the corrosive effect on the shell of any steel vessels lying in the vicinity. Vessels trading to the Port Arthur Channel are often found bare of paint, and it is not at all unusual when vessels go on drydock direct from this service, to find bright spots on the plating and on the points of the rivets, as though caused by the action of an acid. On the other hand, where the coating on the under-water surface has been found still adhering, comparatively less deterioration has been found.

The long period that sometimes elapses between drydockings has also been blamed; the insufficient time on drydock for adequate cleaning and recoating; not to mention the insufficient amount of paint applied, and the inefficient methods of applying same. There is no doubt that this very essential operation is given neither the time nor attention which it deserves.

Statements have been made that the rivets have been overheated, and that the pneumatic hammer, if not carefully used, has a damaging effect on the point of a rivet, particularly a steel rivet. Practically all ship riveting in this country is by pneumatic tools, and it is contended by some that the stroke is too short to properly stave up the rivet. That the use of the pneumatic hammer may have some bearing, may be concluded from the cases of corroded rivets found in rudder arms. If these are riveted by a hydraulic machine, corrosion of rivet points does not seem to be nearly as rapid as when the rivets are air hammered. The trouble has also been attributed to the difference in temperature between heated oil in tanks and the cold sea water outside.

The frequent overloading (perhaps it should be termed "deeper loading") of tankers has also been mentioned as a possible cause, due to which, it is stated, there is a slight straining action on the rivet point on account of the excessive sagging stresses increasing the tendency to corrosion on the rivet points. As against this theory, however, it may be stated that very much worse stresses can be set up due to a badly ballasted condition, which is not at all uncommon.

It should be noted that the rivets affected were scattered evenly over seams, butts, and longitudinals; although in way of the bulkheads the trouble has been found to be

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slightly accentuated. The proportion of rivets renewed at such times due to slackness, to those renewed on account of wastage and corrosion, is small.

No doubt the reasons advanced, as given above, tended to accelerate the riveting trouble experienced, but in several of these cases it was felt that some other explanation had to be sought to account for the trouble. The theories and tests which follow may be of more technical interest than practical, but it is well to remember that progress on the practical side has always followed well-founded conclusions on the theoretical end.

Corrosion Theories

It is a well-known fact that iron and steel have a tendency to revert to their more stable original conditions as found in the various ores. This was very appropriately stated a few years ago by Sir Robert Hadfield before the Iron and Steel Institute when he referred to the "almost resistless tendency of iron to return to its lethargic union with oxygen."

The three main theories may be said to be (*a*) chemical, (*b*) electrochemical (or electrolytic), and (*c*) colloidal.

Chemical Theory.—It was long held that carbon dioxide was the essential factor in the rusting of iron. It was pointed out in its favor that if lime (which destroys carbon dioxide) is present in water, no rusting occurs. Several investigators, however, have published accounts of experiments which seemed to show that iron could rust under conditions which exclude any measurable quantity of carbon dioxide.

Another theory which comes under this category was based on the view that hydrogen peroxide plays an important part in the wet oxidation of metals. Traube showed that hydrogen peroxide was produced during the wet oxidation of many metals. Other investigators, however, have stated that pure hydrogen peroxide does not oxidize iron.

Electrochemical Theory.—Whitney advanced this theory in 1903 by stating that practically the only factor which limits the life of iron is oxidation, under which are included all the chemical processes whereby the iron is corroded, eaten away, or rusted. He stated that the iron always passes into a state of solution in the form of ions (which, he explained, were probably electrically charged atoms), so that in a consideration of corrosion we have really to consider the effects of conditions upon the potential difference between the iron and its surroundings. In his opinion, therefore, the whole subject was an electrochemical one, the rate of corrosion being a function of electromotive force and resistance of circuit.

A later presentation of this theory was made by Aston in 1916, in which he pointed out that the reason why wet rust promoted further rusting was that it acted as a diaphragm, screening the underlying metal from the direct access of oxygen. Thus, he stated, when two pieces of iron are immersed in the same liquid, and one is exposed to the action of dissolved oxygen while the other is shielded from it by means of wet rust, a current is set up, the shielded (rusty) electrode being the attacked pole, or anode. According to this theory, it is contended that iron rust differs greatly from iron in electrical potential.

Colloidal Theory.—Dr. Newton Friend has recently (1921) propounded a new theory. He has stated, in effect, that ferrous hydroxide is formed as a colloidal solution in the corrosion product, and serves as an oxygen carrier or catalyst, becoming alternately oxidized by the oxygen to ferric hydroxide, and then reduced by the iron to ferrous hydroxide. This theory has been attacked by various investigators, on the ground that there is no direct evidence that ferrous hydroxide is capable of so acting as an oxygen carrier.

As it is obviously necessary to postulate a workable theory that provides a reasonable basis for the consideration of the corrosion phenomenon, the electro-chemical theory is now generally accepted as providing a satisfactory explanation, the colloidal theory being very severely questioned by many investigators. Speller and Harmon have expressed the opinion that the electro-chemical theory is the best we possess at the present time, and that the many cases of so-called "chemical corrosion" have not been correctly interpreted. Walker stated in 1908 that one fact remained undisputed namely, that oxygen is necessary for continuous corrosion. This fact has recently been demonstrated by Speller in a practical manner, by the development of protective systems based on the removal of dissolved oxygen from water. Careful experiments were made at the Massachusetts Institute of Technology and at the National Tube Company, Pittsburgh. These demonstrated that the amount of corrosion found is almost directly proportional to the amount of oxygen in solution and varies as the temperature. If the water to be used be first passed through a tank containing steel scrap, the dissolved oxygen will be absorbed by the scrap. Speller maintains that water so treated is practically inactive towards steel or iron, and may be used in boilers or steel economizers without fear of corrosion, so far as the water is concerned. Many plants have been put into service and are operating satisfactorily, based on the removal of dissolved oxygen by means of exposing the water to a large surface of steel or iron.

Influence of Copper Content on Steel

Public attention was recently directed to the influence of copper on steel plates by Dr. G. B. Waterhouse,* as the result of some tests which he made on samples taken from the bottom shell of the *Leviathan*, his attention having been drawn to a badly corroded plate by Professor J. R. Jack.† It seems that when the ship was at Liverpool, five years prior to her being drydocked at Boston, a skeg of British steel was riveted to the bottom shell to carry the rigging for the paravane or otter gear—a mine-sweeping device. In contra-distinction to the plates of the hull, this skeg was found to have been badly corroded, having been under water for five years. An investigation was made as to the chemical composition of the British and German steels, and the implication from the results of the investigation was that the latter resisted corrosion in sea water, due to the presence of a comparatively high percentage of copper. From the analysis given, the German steel showed an average of 0.15 percent copper, while the English steel showed only 0.099.

Whether the copper content in the shell plates of the *Leviathan* tended to render them anti-corrosive in the presence of sea water is still without practical corroboration.

Much has been written recently as to the influence of copper on the anti-corrosive tendency of steel, but very little, so far, of practical importance to the shipbuilder. It should be borne in mind in discussing this subject that it is necessary to differentiate specifically whether we have reference to (*a*) simple atmospheric corrosion, (*b*) simple immersed corrosion, or (*c*) compound immersed corrosion. By the term "compound" is meant the association of different metals, or of two similar metals of different composition.

Simple Atmospheric Corrosion.—There seems to be ground for the belief that a copper content in steel for structural or railroad purposes, where the steel is exposed only to atmospheric corrosion) prevents or retards the tendency to corrosion. Railroad companies have been specifying for some years back, and during the war period, a certain copper content in the steel for their rails, cars,

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pipe-lines, tanks, etc., to prevent atmospheric corrosion. On investigation it will be found that the presence of copper in almost all kinds of steel plates now manufactured is very general. There is a slowly increasing demand for steel with a copper content up to 0.30 percent, especially for sheets and railroad equipment such as tie plates and spikes. This means that more and more scrap containing copper is being returned for use in the open-hearth furnaces. In the process of manufacture this copper is not eliminated, but remains in the finished steel, and it is, therefore, practically impossible to get steel, nowadays, free of copper.

The American Society for Testing Materials (Committee A-5) has been conducting tests for the past nine or ten years. Uncoated steel sheets of different qualities and composition, with and without a copper content, were exposed in suitable positions on roofs of buildings at Annapolis, Md., Pittsburgh, Pa., and Fort Sheridan, Ill. The following list gives the percentages of failures for each series of tests, up to date:

	No. 16 gage (1/16 inch thick)		No. 22 gage (1/32 inch thick)	
	Copper-bearing	Non-copper-bearing	Copper-bearing	Non-copper-bearing
Anapolis tests.....	None	None	None	5%
Pittsburgh tests....	None	81%	84%	100%
Fort Sheridan tests.	None	0.8%	None	57%

The A. S. T. M. tests on atmospheric corrosion have not progressed far enough to make a deduction as to a definite order of resistance. The only finished test is at Pittsburgh where the atmosphere is very acid. The results of these tests up to date, however, seem to show that uncoated copper-bearing metal sheets exposed to corrosion are superior in rust-resisting qualities to similar non-copper-bearing sheets.

Simple Immersed Corrosion.—Tests have also been made in immersed corrosion, but unfortunately these have been limited, so far, to immersion in river, city, and mine water.

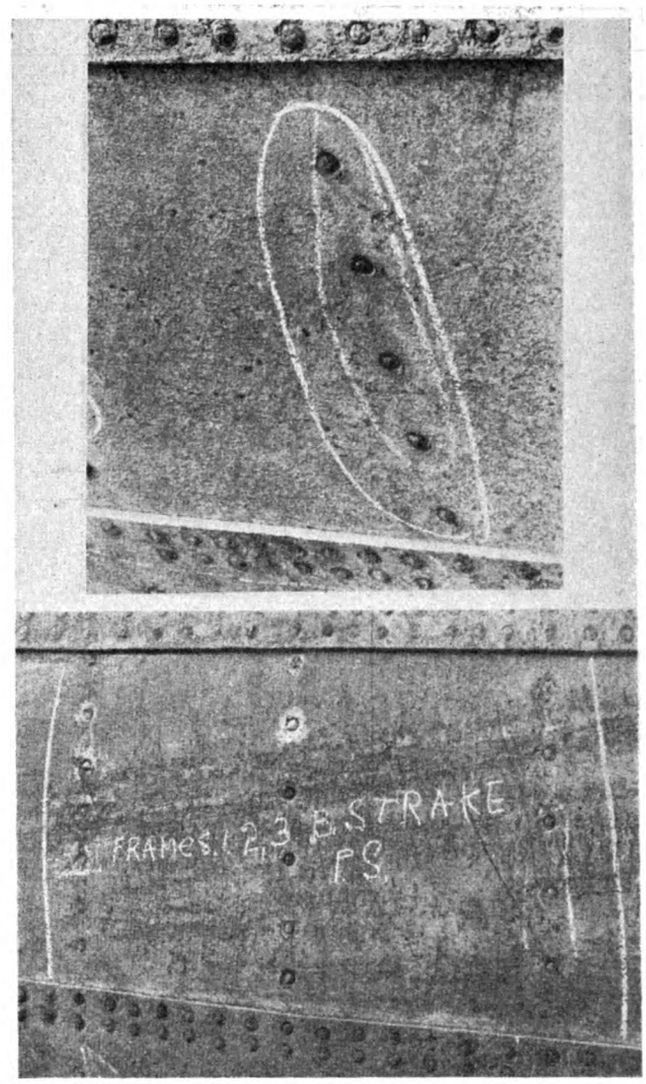
These tests seem to indicate that the greater the rate of corrosion, the smaller is the influence of copper; or, in other words, as the acidity of the water (such as sea water) increases, the value of a copper content in steel decreases.

Compound Immersed Corrosion.—When we turn to a consideration of the corrosion caused by two different metals or two similar metals of different compositions, immersed in contact in sea water (either actual or synthetic), we find that we have an entirely different problem to solve. Very little research work along this line has been done, although the effects in ship structures have been noted from time to time. An example of an electro-chemical action of this nature is that of a steel ship lying at a dock alongside a copper-sheathed ship. If metallic contact is made between the two, the iron suffers by being the anode of a large electro-chemical system, of which the copper-sheathed ship is the cathode, and the sea water the electrolyte.

It is unfortunate that so little investigation has been carried out in connection with the effects of compound immersed corrosion, but experiments are now being made with some of which the writer has been to some extent associated.

Nine sets of plates have been riveted, three sets being low copper steel, three sets being high copper steel, and three sets being high silicon steel. Each of these sets was riveted together with rivets of the following qualities: One row of low copper steel rivets, one row of high copper steel rivets, one row of puddled iron rivets, and one row of ordinary ship quality rivets.

Three sets of the above plates (i.e., one low copper, one high copper, and one high silicon) have been immersed at Portsmouth, N. H., Key West, Fla., and Port Arthur, Tex. They have been immersed in positions below the lowest tide, and to ensure against excessive wave action. It is hoped to have some very interesting results, from these and other tests which are under way, at an early date.



Figs. 4 and 5.—Typical cases of corroded steel rivet points

APPLICATION OF ELECTROLYTIC THEORY

By means of this theory it is possible to explain many cases of corrosion which are frequently found in ships' structures. For example, a corroded shell in way of bronze propeller blades, due to the former being electro-positive to the latter; or the pitting of shell plates, produced by local electrolysis, due to irregularities in composition, rolling, etc. Theoretically, a homogeneous plate, chemically and physically, would not be affected in this way. Plates for shipbuilding purposes are, however, usually heterogeneous both chemically and physically, due to imperfections in process of manufacture, shearing, punching, cold flanging, reaming, etc. It is demonstrable that stressed portions of plates are more prone to corrosion than unstressed, due to the former being electro-positive to the latter. Floor plates are sometimes found eaten away at the round of the flange long before the remainder.

Burgess* has described some interesting experiments which showed that there is a tendency for a heated specimen to become electro-positive, as compared with a cooler portion of the material, when immersed in the same solution. In this connection it might be noted how frequently in cold weather the oil cargo in oil tankers is heated to 130 or 135 degrees F., whereas the sea water may be almost freezing, causing inequalities in the temperature of the shell rivets inside as compared with outside. The conditions of varying temperatures under boilers should also be

*Amer. Electrochem. Socy., 1908.

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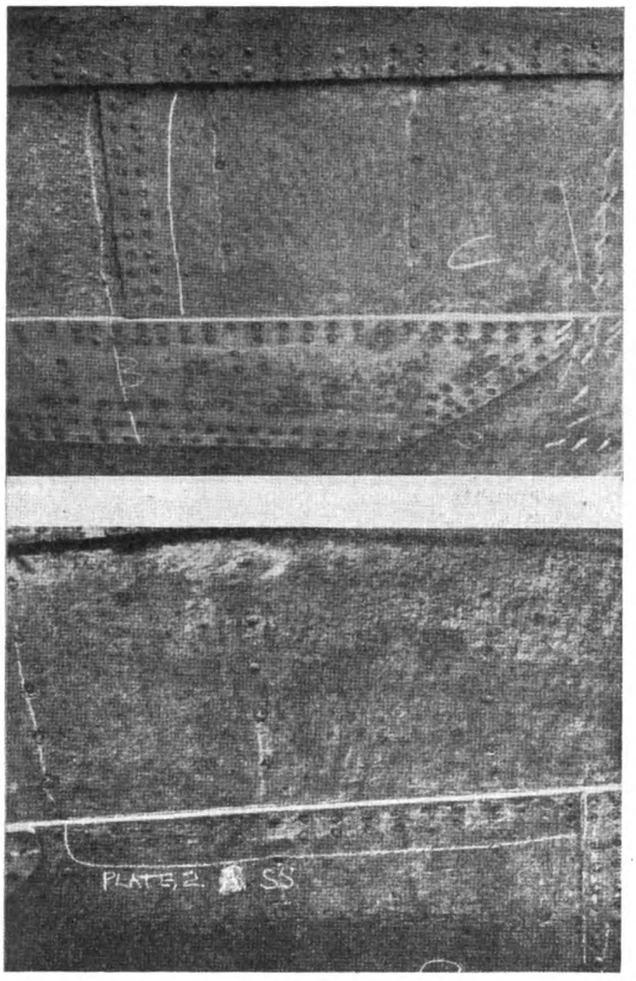

Figs. 6 and 7.—Typical cases of corroded steel rivet points

noted, as it is not infrequently found that the structure at this part suffers severely.

Leakage of electricity, or, as it is frequently called, "stray currents," can cause a serious state of electrolysis. This is shown by the accelerated corrosion found in many cases of steel underground pipes.

In considering the cases of corrosion of rivet points, it was thought that this condition might be due to a difference in electrical potential, caused by varying combinations of plate and rivet, or by stressed conditions, in the presence of a suitable electrolyte (such as sea water or internal bilge water). An interesting case of wastage and corrosion on shell rivet points which came to the writer's attention was that of a freighter which came on drydock for bottom repairs. She had about half the bottom shell plating renewed, particularly at the fore end. She was built about nineteen years ago, the original plates being of steel, and the rivets of iron. The renewed bottom shell plates were of the usual ship quality, coming up to the usual standards for physical tests. On completion, the repairs were thoroughly examined, and the steel rivets were found reasonably full and well driven. The bottom was coated with two coats of anti-corrosive and one coat of anti-fouling paint. After being in service continuously for about nine months, sailing mostly in the Atlantic, and not trading to shoal-water ports, she was again drydocked, when it was found that the steel rivets which were driven in the new plating about ten months previously were very badly corroded on the points. Photographs of the condition are given in Figs. 4 to 9. The points were wasted away, in some cases well below the surface of the shell plating, and were of a honeycomb appearance (see Fig. 10).

Practically all the steel rivets driven ten months previously were affected, with the exception of those in the upper seam connecting the original plates to the renewed plates; although it should be noted that this seam was still partially coated, whereas the bottom of the vessel in way of the new plates was practically bare of paint.

The question at once arose as to the reason for this distressing condition. She had been nine months in the water without drydocking, but the wastage and corrosion affected only the new riveting. The remainder of the bottom riveting (nineteen years old) appeared unaffected. Naturally, therefore, some explanation was sought, and, in an endeavor to establish whether there was any pronounced electrolytic action going on between the plates and the new steel rivets, the following tests were made:

(Then follows a description of a series of tests of difference in electrical potential, when immersed in sea water, of the original plating, the new plating and the original iron and new steel rivets. It was found that while the steel rivets were electro-positive to the new shell plates, the iron rivets were electro-negative.)

As a result of these experiments, practically all the steel rivets which had been driven ten months previously (approximately 8,500) were removed, and replaced by iron swellneck rivets. The analysis of these iron rivets was: Carbon, 0.08; manganese, 0.02; phosphorus, 0.115; sulphur, 0.010; silicon, 0.10; copper, 0.02; slag and oxide, 0.50.

The bottom was again recoated and the vessel placed on her regular run. She has since been examined twice on drydock, at periods of about seven months apart, when it was found that the riveting has remained in good condition, with no evidence whatever of a similar condition developing on the points of the iron rivets as had been the case with the steel rivets.

The main object was to find whether the rivets were anodic or cathodic in respect to the plates, and the results have been substantiated so far in practice. It is now generally accepted that both chemical and electrical influences are involved in the process of corrosion, and it is a well-established fact that when two metals of different electric potential are in contact with an electrolyte, such as sea water, the electro-positive metal suffers wastage from the effect of the current generated, and there seems to be no adequate reason, therefore, why the association of plates and rivets of different composition should not, in certain circumstances, have a corrosive effect on the rivet, especially where the bottom is bare of paint.

On completion of the above tests it was thought desirable to carry out some supplementary investigations to determine the cause and amount of electrolytic action which results from the use of different quality materials (particularly plates and rivets) in the under-water hull structure.

It is an established fact that metals can be arranged in an electromotive series, such that any metal is electro-positive to any other following it, in the sense that it will dissolve (or corrode) and cause a flow of current through the solution to the metal lower on the list, if immersed in contact in a suitable electrolyte. The following is such a list: Zinc (positive) strained steel, steel, strained iron, iron, tin, lead, copper, silver, platinum, gold (negative).

(Here follows a record of a series of tests made with the object of determining the position, electrolytically, of samples of various materials used in ships' hulls, and also to determine the average voltage of these materials while in process of corrosion.)

The average amount of low copper steel dissolved during these tests in 400 minutes was found to be about 0.09 gram.

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As a matter of interest it might be noted that, assuming the electrolytic action between high and low copper steels proceeded at the same rate as given in Table 1 continuously, a new rivet would be wasted to 3/16-inch below the surface of the shell in about eighteen months.

The following are among the deductions made from the tests:

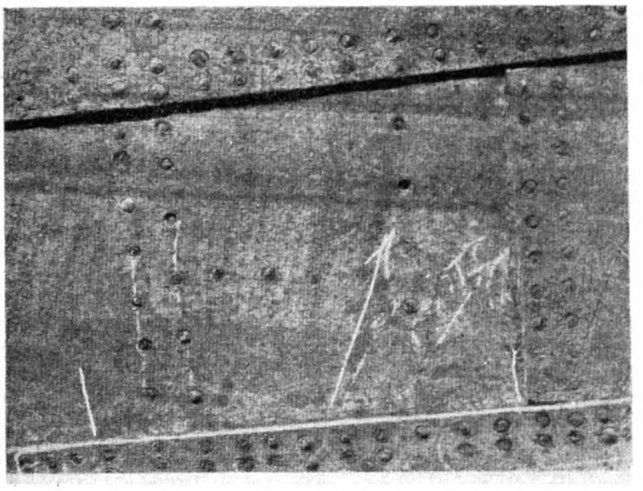
As the copper content in rivet steel increases (within the range of the specimens used in these tests), the lower is the position of the metal in the electrode-potential series; consequently the more electro-negative (or corrosion resisting) is the rivet, when in contact with steel of ordinary (low copper) shipbuilding quality and immersed in sea water.

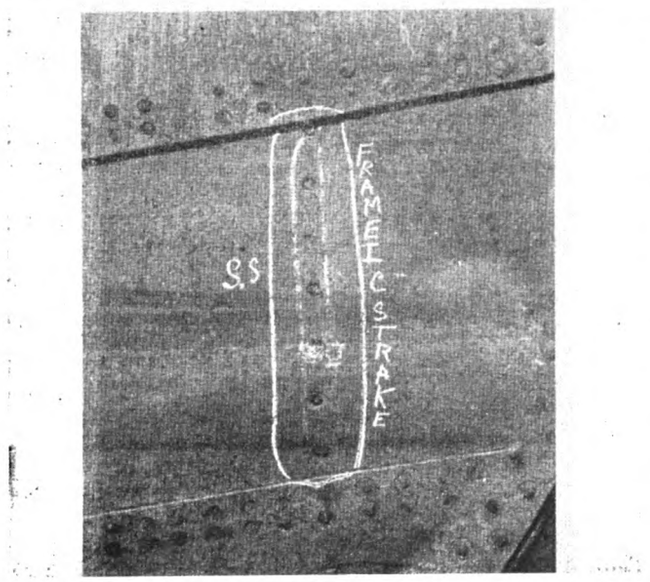
High elastic limit mild steel and high silicon steel (both high carbon steels) are electro-positive to steels of ordinary low copper quality when they are in immersed contact in sea water.

The potential of the rivet after being driven is higher than before, and the higher the driving temperature, the higher the potential.

It is obvious from these tests that the component parts of the hull structure should, after the riveting operation is completed, have no difference in electrical potential, especially those portions which are constantly immersed. In particular the bottom shell of vessels which scrub over shoal water, and are therefore generally bare of paint, should be given very careful consideration in this respect. As it is difficult and almost impossible to realize this in practice, the alternative is to make those portions slightly electro-positive which can more easily endure the effects of this corrosive action, in the same way that zinc strips are placed in way of bronze propellers; or, in the case of shell plates and rivets, to arrange that the former be slightly electro-positive to the latter. The resulting corrosion can be more easily taken on the larger area of the plates rather than on the smaller area of the rivet points, with comparatively less intense and localized wastage.

Fig. 10.—Spongy steel rivet point





Figs. 8 and 9.—Typical cases of corroded steel rivet joints

It would seem at first thought that the plates and rivets should be of exactly the same chemical composition, but, as already explained and as the tests show, a rivet has generally a higher electrical potential after being driven than it had before, which would upset the potential balance between the plate and rivet. It has been shown, on the other hand, that an iron rivet is generally electro-negative to plates of ordinary shipbuilding quality, and it has been established in practice that iron rivets are much more corrosion-resisting than are the steel rivets ordinarily used. Further, the type of corrosion on iron rivets is of the nature of an even pitting in the central portion, whereas in ordinary steel rivets the corrosion is spongy and shows evidence of severe wastage not only in the center but all around the countersink.

An interesting conclusion drawn from the later tests, however, is that high copper steel rivets, when fitted in plates of ordinary shipbuilding quality, are electro-negative to the latter, which would probably render them corrosion-resisting. This has not been tried out in practice, but the immersion tests now being carried out will supplement our information on this hypothesis. If steel rivets are preferred, it is suggested the copper content be specified from 0.20 to 0.30 percent, with a maximum carbon-content of 0.20 percent. On the other hand, the shell plates should have a maximum copper content of about 0.15 percent. Such a combination of plate and rivet should render the plate slightly electro-positive to the rivet, and, for this reason, could be considered as a suitable alternative to the iron rivet.

It is interesting to note that vessels plying on the Great Lakes scrub on the bottom of the Soo Locks and portions of the Detroit and St. Clair Rivers, are very rarely dry-docked except for damage repairs, and yet, in spite of same, no such riveting trouble has been found on any of these vessels. This would seem to substantiate the electrolytic theory, inasmuch as fresh water has a very high resistance (i.e., practically a non-conductor when considered as an electrolyte), whereas salt water is a good conductor.

The chief apparent difference between iron and steel rivets in composition is the presence of slag in the former

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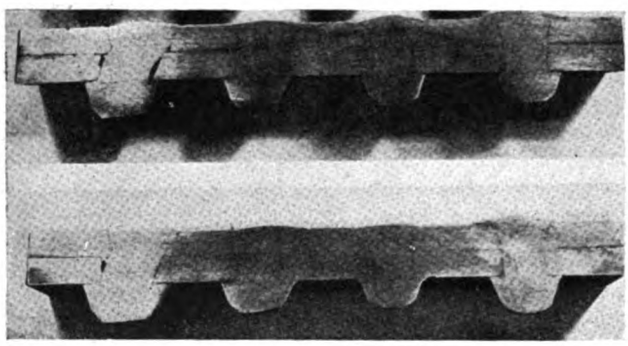
and its absence in the latter. As much as 0.5 percent to 0.9 percent slag is found in iron, whereas, in steel, slag is practically nonexistent. It has been stated that, in the case of iron, each crystal is surrounded by an envelope of slag which fills the intervening spaces, and that the successive rolling operations elongate the crystals (enclosed in a matrix of slag), thus giving iron its fibrous structure. It has been claimed, too, that the well-known anti-corrosive property of iron is due partly to this protective coating of slag around the fiber, together with the fibrous regularity of the structure. The Delhi Column is sometimes referred to in this connection. It was constructed of welded wrought iron discs, and, although built as early as 319 A. D., still stands as a monument to the corrosion-resisting quality of iron.

It is of importance to note that a low carbon rivet is less liable to the effects of overheating than is one of high carbon content.

To test the amount of "staving-up" in the case of steel rivets as compared with iron rivets, two plates, each half an inch thick, were riveted as shown in Figs. 11 and 12, and afterwards sawn through and polished. Fig. 11 shows the plates riveted with steel rivets, and Fig. 12 shows similar plates with iron rivets. The two rivets on the right are ¾-inch diameter, the holes fair, but it will be observed the point in one of these is "mushroomed" or spread beyond the countersink of the plate. This is a common occurrence and a very bad one, as the point cannot be efficiently calked, and if any attempt is made to do so, the material of the rivet beyond the countersink tends to lift or break off, thus impairing a close contact of rivet point and plate. The other two holes were intentionally made quarter-blind and half-blind respectively, and in the latter case the holes had to be reamed at an angle to a size larger, and a ⅞-inch diameter rivet fitted. The comparative amount of "staving-up" in the case of the steel and iron rivets should be observed. The specimens were treated with



Figs. 11 and 12.—Sections of riveted plates

dilute acid in order to bring out clearly the contour of the body of the rivets within the plates. The "fibers" of the iron rivets are clearly shown in Fig. 12.

Fig. 2 shows a typically corroded iron rivet recently removed from the bottom of an oil tanker. The difference between a corroded iron rivet point and a corroded steel rivet point will be realized by comparing Figs. 1 and 2. The steel rivet point is generally found to be eaten away below the level of the plate and honeycombed or worm-eaten in appearance; whereas in the case of the iron rivet the corrosion (which is not as active) shows a uniformly lined surface, somewhat similar to the grain found on a piece of planed soft wood which has dried after being wet. In the case of iron rivets the countersink is usually found to be closed, the deterioration being in the central portion of the rivet point. It should be noted that, when referring to iron rivets, puddled iron is meant.

Pitting and General Corrosion

It has long been recognized that the contact of metals of different composition or of different electric potential (including mill scale), in the presence of water, accelerates corrosion locally on the steel, causing pitting. A film of rust is electro-negative to the underlying metal, and thus stimulates further corrosion. If a metal were absolutely uniform, both chemically and physically, there would be no electro-chemical corrosion. In other words, pitting has been found to be caused by the presence of electro-negative impurities or differently stressed conditions on the surface of the plates. Such electro-negative impurities may consist of mill scale, rust, or carbon, etc., these having been left on the surface after rolling.

It is interesting to note that, whereas American oil tankers are found to suffer more from wasted rivet points than from pitting of plates, the reverse is the case in many British oil tankers. A positive explanation of this may be due to the fact that in American tankers steel rivets are used which have frequently been found to be electro-positive to the plates (thus causing wastage on the rivets), while in British tankers iron rivets are used which are usually electro-negative to the plates (thus tending to cause corrosion or accelerate pitting on the plates).

Pitting on the outer shell is usually found between the light and load waterlines. An example of this is shown in Fig. 13. As regards internal pitting and corrosion, this is found most often in oil tankers carrying gasoline, and particularly in those tanks which are used frequently as ballast tanks. Vessels carrying the lighter refined oils have been found to be disposed to this corrosive action on the plating and rivets, particularly as in the case, where the tanks have been used alternately for water ballast and oil. In fact, it seems to be the rule rather than the exception, and no means has been found so far which will prevent this. Tanks used for the carriage of heavy oils do not seem to be affected to the same extent.

It is very undesirable that an oil tanker be retained in the refined oil trade exclusively. Such vessels should be changed, say about every five or six years, from the refined to the heavy oil trade. This has a tendency to check the serious corrosion found in tankers engaged exclusively in the light oil trade. In one case recently examined, the vessel had been engaged in carrying refined oil for about ten years. The bulkheads, shell, longitudinals, etc., were very heavily coated with thick scale, while the heads of the shell rivets were more or less eaten away (see Fig. 3). Some of the heads were so wasted that a sharp blow from a hammer severed the head almost completely from the body of the rivet. The worst condition in this vessel was found within the expansion trunk, and especially inside the hatch coamings and covers. It was estimated the material within the expansion trunk had decreased about 50 percent in thickness during the ten years that the vessel had been engaged in this trade (i.e., since she was built), and that the hatch coamings and covers had decreased to about ⅛ inch thick, or about 60 to 70 percent reduction.

Conclusion

In this paper emphasis has been particularly directed to the effect of electrolytic action resulting from the immersed contact of two grades of steel or of two different metals, this being an aspect of the subject which it was considered desirable to investigate. It must not, however, be concluded that this answers the whole problem of corroded rivet points, but attention is directed to this as one phase worthy of serious consideration, especially in new construction.

It has been shown independently by many investigators, including Bauer, Burgess, Friend, Heyn and Speller, that (*a*) increase in stress or strain, (*b*) increase or inequalities

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in temperature, (*c*) increase in speed of the solution in which metals are immersed (at least up to a critical speed), increase the rate of corrosion. Each of these (and others) is, unfortunately, a factor which must be reckoned with in a study of corroded rivet points, and it is difficult, if not impossible, to state which is the chief offender. It is recognized that overloading, or a badly ballasted condition, subjects oil tankers to very severe stresses, particularly in the sagging condition, which greatly increases the shearing stress on the bottom rivets. The effect of scrubbing over a sandy or muddy bottom is one that has not yet been thoroughly investigated.

Enough has, however, been said to show that whether the serious wastage and corrosion recently found on the rivet points on the bottom of many vessels is due to electro-chemical action consequent to their scrubbing over muddy bottoms at shoal-water Gulf ports, to overheated or overcalked rivets, to the action of polluted rivers, to the composition of the rivet steel and plating, to unduly long periods between drydocking, to insufficient or inefficient cleaning and painting, or, as is probably near the truth, to a combination of causes including all of these and possibly more, the very greatest care and forethought are necessary in both the selection of suitable materials and in the work of building them into the hull of the ship.

The increasing copper content in steel is suspected by some to be the "nigger in the woodpile," but if judicious selection of materials for plates and rivets is made, there is no reason why this should be so. It has been demonstrated that copper-bearing steels (say over 0.15 percent copper) are preferable in cases of simple atmospheric corrosion, but that in simple immersed corrosion no advantage is found; rather the reverse. In compound immersed corrosion, the results of the laboratory tests show that high copper steel rivets (say 0.20 to 0.30 percent copper) might with advantage be used in hull plates of the usual low copper quality, in preference to low copper steel rivets. The use of puddled iron rivets in preference to low copper steel rivets, in the under-water body of vessels which frequently scrub on the bottom, has recently been adopted by several owners. In doubtful cases, iron is generally a safe choice, but the use of high copper steel rivets might also with advantage be advocated. Iron rivets are costlier than steel rivets, but inasmuch as, in the case of a repair job, labor costs about 90 percent of the total, the price of material is not, comparatively speaking, of so much consequence. Iron rivets are softer, easier to hammer up, fill the holes better, do not require to be heated to as high a temperature and in any case are more foolproof to overheating, and the point is not as sensitive to working conditions.

Riveting by means of the pneumatic hammer, which is universal here, is performed in a rapid succession of comparatively light blows. Unless the work is carefully supervised, the tendency with air tools is to harden up the point only, without properly staving-up the body of the rivet.

In the case of rivet renewals, great care should be exercised in removing the old rivets. The habit of burning out rivets from the point inward is particularly objectionable, as the torch frequently destroys the metal adjacent to the hole. A better practice is to burn the heads off and back the rivets out. Before re-driving, the holes should be carefully reamed and re-countersunk, and, where partially blind holes are found, these should be reamed out, recountersunk and a larger size rivet fitted.

Too much calking is sometimes done around the points, often forming a niche which destroys the material around the hole, and gives a starting point for corrosion. Where rivets are properly driven there is no necessity for the indiscriminate and large percentage of calked rivets done nowadays. The calking of rivet points should be considered a temporary measure at best. It should be allowed as a last resort, and only after permission to do so has been granted.

Fig. 13.—Pitted shell plates

Greater care might be exercised in the cleaning, scaling, and recoating, especially of the under-water body, and the obtaining and preserving of a good coating on all underwater surfaces should be emphasized. As far as the writer's observation has gone, these operations are sometimes carried out with less care than they deserve, and owners ought to insist and see that they get value for the expense entailed each time their vessel goes in drydock. If this were done, there is no doubt that a great deal of the trouble now experienced would be avoided.

Further, it has been ascertained that some owners have, in the past, been rather lackadaisical about the periods between drydockings, and in some cases have allowed their vessels to remain in the water without recoating much longer than advisable. In the case of vessels which trade to shoal-water ports, it would seem reasonable to drydock these for cleaning and recoating at about six-month intervals. The first few months after launching or repairing form the critical period in regard to the coating on the bottom. The vessel might with advantage be recoated three months after launching, and then at six months thereafter. In several cases of serious bottom corrosion and pitting of shell, it was ascertained that the vessels had not been drydocked for from twelve to sixteen months after launching.

In other words, the responsibility for much of this trouble cannot be laid entirely to either the steel manufacturer, the shipbuilder, or the superintendent. It is as much a question of upkeep as of construction and material. Supposing, for example, that an oil tanker proceeds south to a Gulf port in ballast immediately after she has been built or drydocked, as is commonly the case, is loaded and then driven through shoal water, mud, and sand, engines going full speed while the vessel makes but a few knots, and this for several miles, the owner who expects the bottom of his vessel to remain in first-class condition under such treatment is indeed an optimist. If, added to this, he never drydocks the vessel under eight or ten months, barring accidents, and sometimes twelve months or longer, it is easy to deduce that the bottom is bare of paint for practically the life of the vessel. It must not be concluded that only vessels which scrape the bottom have experience of this trouble, although these cases are the most serious. Roughly speaking, vessels trading between New York or Philadelphia and California probably suffer 75 percent less deterioration than those trading to Gulf ports.

As regards the question of overloading of tankers, the

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particular objection as affecting the riveting trouble is in the deeper draft of vessels leaving Gulf ports, and the consequently greater amount of scrubbing. Shipowners are paying a heavy penalty, in this respect, by sacrificing their property for the deadweight represented by the difference between the Plimsoll draft and the scantling draft; that is, in vessels trading to shoal-water ports.

Some further investigations are under way to complete the information on this subject. A study of this problem is all the more necessary, due to the introduction of high tensile steels for shipbuilding purposes. One such, known as "high elastic limit mild steel," has been used in the construction of a vessel recently constructed in Scotland, in which a reduction in scantlings was allowed due to the higher physical qualities. Another high tensile steel known as "high silicon steel," with somewhat higher physical properties than the above, has recently been used extensively in bridge construction in this country. As to whether such special steels, if exposed in a similar manner to the cases quoted at the beginning of this paper, would show any marked corrosive or anti-corrosive tendency is a matter for careful consideration, but the tests made would seem to point to a smaller liability toward this trouble, these special steels being slightly higher in the electrode-potential series.

It has been my purpose in this paper to emphasize the importance of:

(*a*) Careful selection of materials which are intended to be immersed in close contact in sea water, with a view to the preservation of the rivet points.

(*b*) Careful inspection and workmanship during construction or repair.

(*c*) Calking of rivet points should not be allowed on new work, except as a last resort.

(*d*) Reasonable care in the vessel's upkeep, including more frequent drydockings (say every six months), and greater care in cleaning, scaling and recoating.

(*e*) Overloaded and badly ballasted conditions should be avoided as much as possible.

(*f*) In the case of vessels trading to shoal-water ports, or engaged in a service where difficulty is encountered in retaining a good coating, it is recommended that either iron rivets or high copper steel rivets (say 0.20 to 0.30 percent copper) be used in the keel and bottom shell up to at least the upper seam of the bilge strakes, tapering to a point on the stem and sternpost at about half the draft.

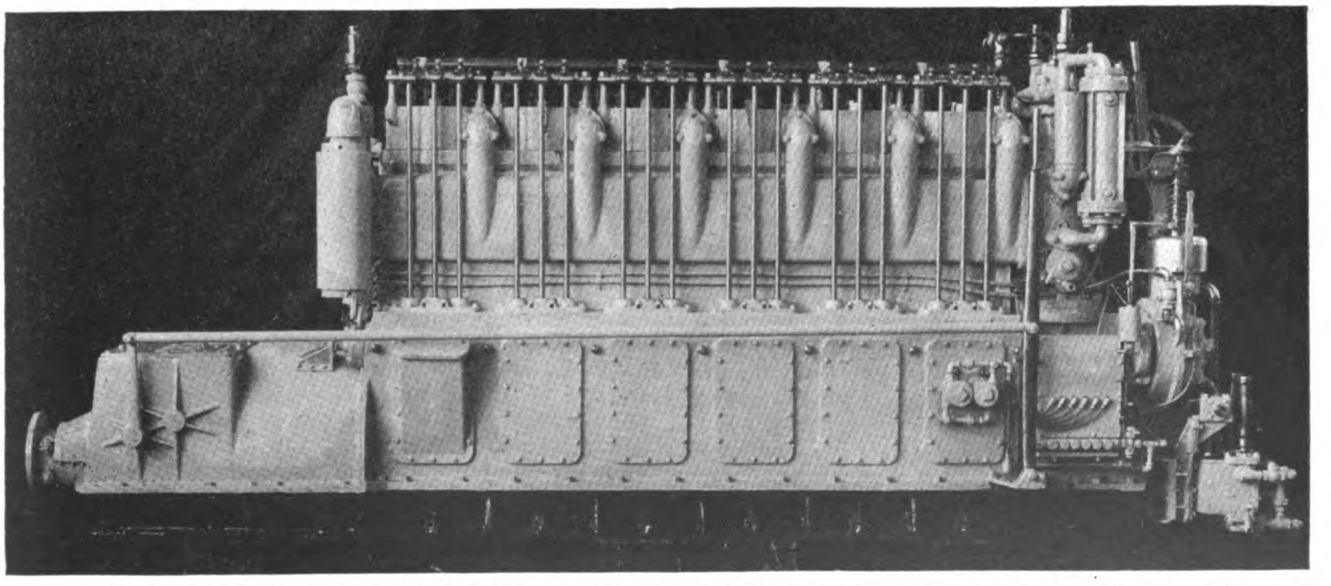
It is hoped that these remarks, by concentrating attention on this perplexing problem, may help towards its final solution.

Winton Coast Guard Engines Exhibited at New York Motor Boat Show

THE Winton Engine Company of Cleveland, Ohio, exhibited at the annual Motor Boat Show, held at the Grand Central Palace, New York city, January 21 to 29, a pair of their Model 114 Diesel engines and also one of their Model 109 air compressor sets. The Winton Model 114 is the engine which the United States government has recently installed in 44 of their Coast Guard patrol boats. Each of these boats, which are of exceptionally sturdy construction for long-continued sea service in all kinds of weather, is powered with a pair of these engines and one Winton Model 109 air compressor set. The Winton Coast Guard engine is rated at 150 horsepower at 450 revolutions per minute. It is of the 6 cylinder 4 cycle single acting type arranged for air injection of the fuel. The cylinders are 18 inches in diameter by 11 inches stroke and each engine weighs 13,500 pounds. A complete description of these engines with detail drawings was published on page 461 of the August, 1926, issue of MARINE ENGINEERING AND SHIPPING AGE.

MODEL 109 AIR COMPRESSOR SET

The Winton Model 109 air compressor when running at 700 revolutions per minute delivers 3 cubic feet of air per minute at 900 pounds per square inch. It is driven by a 3 horsepower Westinghouse electric motor, the complete set weighing 750 pounds. The crank case and low pressure cylinder of the compressor are cast integral of close-grained charcoal iron. The crank case is provided with end plates which carry the main crank shaft bearings. The intake valves are of the mushroom type and the exhaust valves of the usual thimble design. Low and high pressure air coolers are made of extra heavy copper tubing wound around the compressor cylinders.



One of the Winton 150 horsepower Diesel engines built for installation on U. S. Coast Guard patrol boats exhibited at the New York Motor Boat Show

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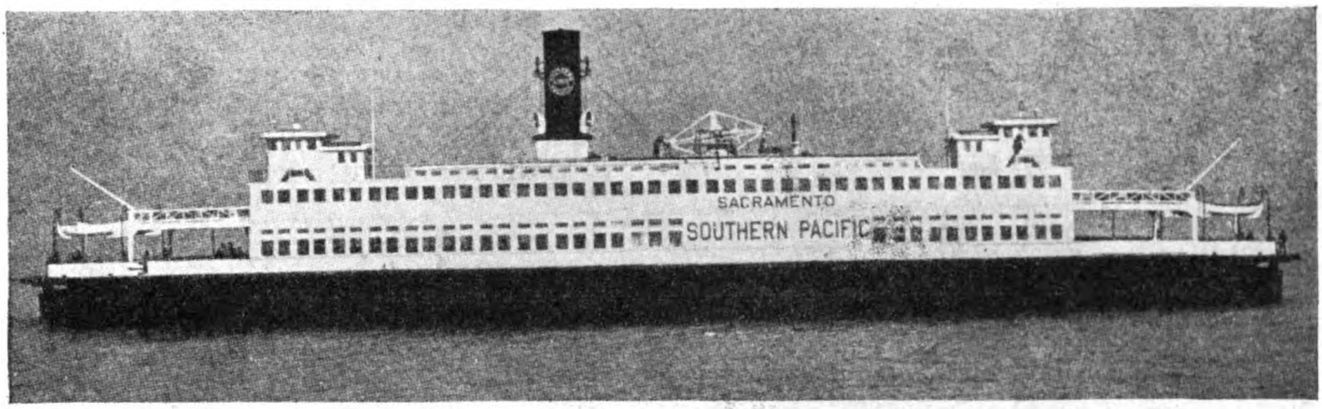

Fig. 1.—The largest side wheel passenger ferryboat, S. S. Sacramento

Some Considerations in the Design of Ferryboats*

Outstanding problems which have arisen in the design and operation of passenger ferryboats in service on San Francisco Bay

By Chas. F. Gross† and Chas. Green‡

THE marvelous development of railway transportation in recent years, the increased railway traffic, both freight and passenger, has made it incumbent for many railroads whose terminals are located in harbors of importance or whose rails touch such harbors to maintain a considerable amount of floating equipment to complete their delivery agreements. Probably nowhere does this kind of equipment become so necessary as in the ports of New York, Detroit, and San Francisco, where all the railroads require vessels to complete their deliveries in whole or in part. Of the territory covered by this water-borne movement in San Francisco Bay the Southern Pacific Railroad Company has by far the larger areas to serve, which consequently means a large amount of floating equipment. The sizes of the various units and character of equipment vary considerably, but all are of a design that experience has shown to be appropriate. In most cases the ferry steamer begins or ends a haul of a passenger which has been brought to the steamer by a railroad operated in conjunction with the floating equipment. On San Francisco Bay the following companies are operating, all more or less with the above type of haul: Southern Pacific Railroad Company, the Key System Transit Company, the Northwestern Pacific Railroad Company, the Santa Fe Railroad Company, the Western Pacific Railroad Company, and the Golden Gate Ferry Company.

Several of these ferries have a seating capacity of 2,340 and a carrying capacity of 4,000 passengers, the largest type of vessel used for the conveyance of passengers. But when one also realizes that the run for a vessel of this type is only 14 minutes, the handling of large crowds is at once apparent. The average mileage made by these steamers is approximately 50,000 miles per year, probably the greatest of any boats in the world, transferring some 55,000,000 passengers together with express, baggage and mail. In addition to this passenger traffic on San Francisco Bay there are steamers engaged in transporting automobiles, trucks and other vehicles, transferring over 2,500,000 vehicles yearly.

Subdivision

A satisfactory system of subdivision is an important factor in the safety of these steamers, due to the risks of accidental flooding and the serious consequences as a result of a faulty or insufficient arrangement of bulkheads. The discussion, therefore, arises as to the merits of providing longitudinal bulkheads as part of the watertight subdivisions on these steamers in conjunction with the usual transverse partitions. Where an arrangement has been carefully designed and where effective bulkheads are built to prevent excessive heeling in the event of a wing compartment being flooded, the effect may be beneficial, but in other cases the longitudinal bulkheads are likely to accelerate disaster. With our ferryboats which have been designed and built within the past two years, longitudinal bulkheads have been incorporated into the subdivision of the hull, which has raised the point in the minds of some of our profession as to the efficacy of this means of subdivision.

The section of the report of the committee appointed by the president of the British Board of Trade to consider the subdivision of merchant ships appertaining to watertight longitudinal bulkheads and inner skins is as follows:

"We have given careful consideration to the question of fitting longitudinal vertical subdivision, especially in the form of side bunkers, and we are of the opinion that such subdivision does in certain circumstances constitute an addition to the safety of the vessel. Extensive flooding of bunkers on one side of the vessel, however, might cause a heavy list, and, apart from the danger of capsizing, might render it difficult to utilize all the boats or to maintain her navigability. Many suggestions as to the manner in which such listing might be counteracted have been put before us. Certain of the suggested arrangements consisted of means for allowing water to flow into the side compartments opposite to those damaged; that is, by means of sea cocks or interconnecting ducts. We do not feel justified in advising that any of these should be accepted so far as watertight side bunkers are concerned. Arrangements for pumping water into such bunkers might, however, be accepted if the details were satisfactory, and arrangements for interconnecting oil-bunkers or spaces between double skins by pipes or ducts might be accepted under the same conditions. It must be recognized, however, that in the event of an accident causing the immediate flooding of the bunkers or other spaces on one side, no arrangements would be sufficiently speedy to prevent a list developing, and it is therefore necessary that, if watertight longitudinal bulkheads or inner skins are fitted, it should be proved that the margin line will not be brought under water when any space bounded by transverse watertight

* Extracts from a paper read at the thirty-fourth general meeting of the Society of Naval Architects and Marine Engineers, held in New York, November 12, 1926.

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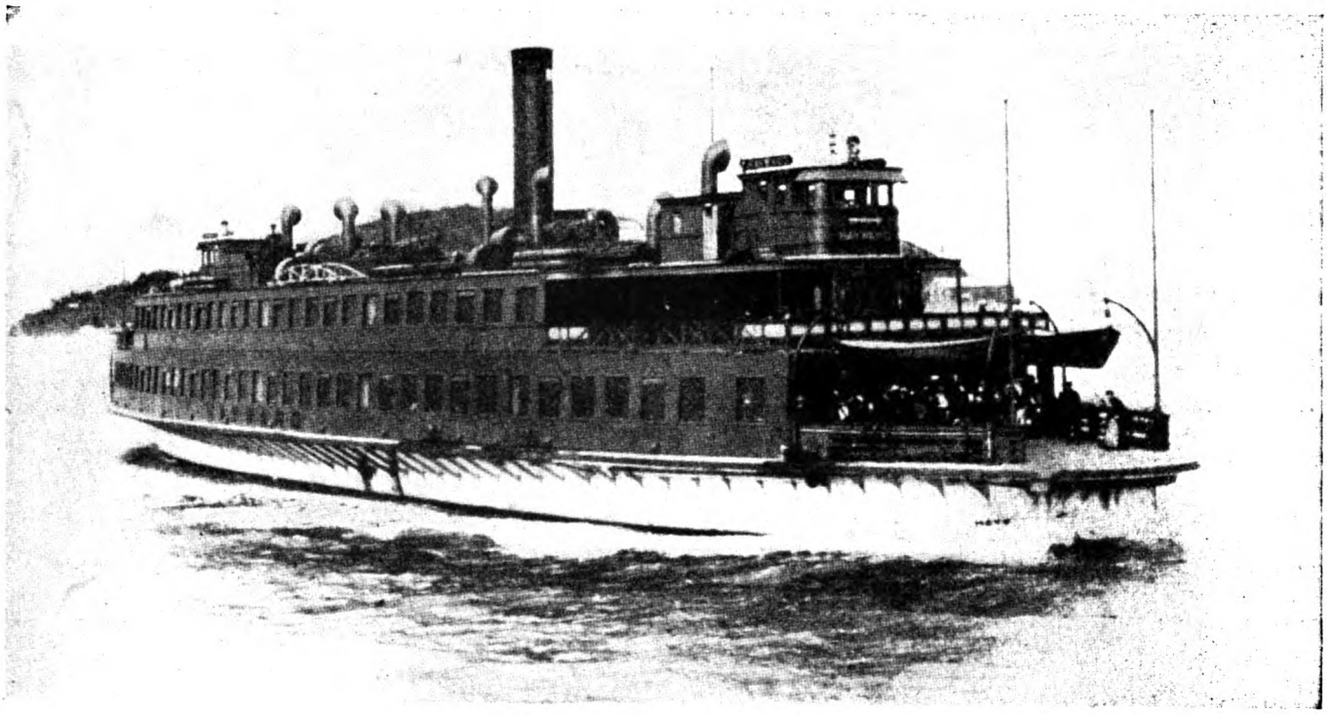

Fig. 2.—Turbo-electric ferry Hayward, under way

partitions between the outer skin and the inner skin or longitudinal bulkhead on one side is flooded for a length equal to the floodable length of the vessel in that region, as determined for transverse subdivision only. The distance of an inner skin from the outer skin at any part should not be less than 2 feet plus 2 percent of the molded breadth of the ship."

It will be seen from the above that, although the Bulkhead Committee has given its approval to longitudinal bulkheads, it has done it reluctantly. It must be remembered that ferry steamers running on San Francisco Bay, as well as in New York Harbor and elsewhere, operate in fog and cross river and bay traffic under more hazards than passenger vessels do at sea, and for this reason we think the protection should be greater. To us it seems that this protection is not afforded by longitudinal bulkheads and that the water-traveling public is given a false sense of security by their use. It is evident that any system of longitudinal subdivisions or pontoons that is substituted for guard braces may be valuable as contributing to the safety of the ship when the volume of space liable to be flooded by collision is so moderate that their flooding would cause no serious list. Actually what has been done is that these wing partitions have been subdivided by divisional bulkheads into comparatively short lengths.

It must not be lost sight of that in most cases the ferry is protected by a heavy guard fender outside of the vessel which may consist of steel plating, a 14-inch by 14-inch fender, and in many cases by a complete steel deck, all contributing to the protection of the steel side of the vessel in case another ship should ram the ferryboat. Ample protection can be secured by a system of transverse subdivision which has been recognized as the most effective means to insure safety from heeling in case of accident.

Types of Machinery

On San Francisco Bay the ferries have as their propelling machinery practically every type of engine. They may be grouped under the following divisions:

1. Four-cylinder compound reciprocating engine driving screw propellers.
2. Triple expansion engine driving screw propellers.
3. Beam engine driving radial paddle wheels.
4. Inclined double tandem compound engines independently connected to each radial paddle wheel.
5. Single inclined cylinder direct connected to radial paddle wheels.
6. Inclined cross-compound engines direct connected to feathering paddle wheels.
7. Turbo-electric drive with an electric motor at each end.
8. Diesel electric drive with an electric motor at each end.

The side wheel ferryboats on San Francisco Bay are powered with inclined cross-compound engines direct connected to feathering paddle wheels; beam engines with both surface and jet condensing installations driving radial paddle wheels; double tandem compound inclined engines independently connected to each radial paddle wheel and single cylinder inclined engine driving radial paddle wheels. The propeller ferryboats are powered with four-cylinder compound engines and triple expansion engines directly connected to bow and stern propellers.

A conviction on the part of many engineers that reciprocating steam engines had reached a stage of efficiency that could not be increased without a more than corresponding cost of operation led to the building at first of two Diesel electric boats, followed by the building of two turbo-electric boats. For durability, reliability and low cost of maintenance, the beam engine for side-wheel ferryboats cannot be excelled.

Turbo-Electric Propulsion

This type of propulsion has been installed in the Key Company's ferryboats *Hayward* and *San Leandro* (see Fig. 2) on San Francisco Bay, which use direct current, while in New York Harbor may be seen the ferryboats *Rodman Wanamaker, W. R. Hearst,* and *George W. Loft,* with the alternating-current installation. There are under construction now two ferryboats for the Key System which will also have the turbo-electric drive. The following is a brief résumé of the installation as it exists on the *Hayward* and *San Leandro.*

The boiler plant consists of two Babcock and Wilcox watertube boilers, as shown in Fig. 3, having a total heating surface of 5,000 square feet generating steam at a pressure of 225 pounds per square inch. They are equipped with superheaters to give 65 degrees of superheat. The turbine generator unit (Fig. 4) consists of a three-stage

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Curtis steam turbine connected through a single four-to-one reduction gear to a 1,000-kilowatt direct-current generator. As will be noticed from Fig. 4, the exciter is on the same shaft as the main generator. The equipment was manufactured by the General Electric Company. The condenser is a Wheeler surface condenser which maintains a vacuum of 28½ to 29½ inches; the circulator is driven by a 30-horsepower Curtis steam turbine running 1,500 revolutions per minute. The direct current generator is rated at 1,000-kilowatt, giving a full-load current of 2,000 amperes at 500 volts. It is a six-pole shunt wound machine, so designed that it has a considerable overload capacity for short periods. The field is separately excited from a small 115-volt, 75-kilowatt generator direct connected to the large generator shaft. This small generator also supplies the excitation for the propulsion motors and the current for all lighting on board.

The propulsion motors, Fig. 5, consist of two General Electric Company direct current motors of 1,200 horsepower each. They are located at opposite ends of the boat, direct coupled to the two independent propeller shafts. The motor is of double armature type, being essentially two machines mounted on the same shaft side by side, and operated in series, each taking 250 volts. The reason for the two armatures is that one armature would make a large diameter motor, too large to place it as far aft as is possible with the double armature type. Under normal operation the stern motor is the driving motor and runs at 125 revolutions per minute while the bow motor idles at about 100 revolutions per minute. At 100 revolutions per minute the bow motor takes 260 amperes and develops 150 horsepower. On the return trip the speed relations of the two motors are reversed. The stern motor, which was formerly the forward motor running at 100 revolutions per minute, now runs at 125 revolutions per minute; and the bow motor, which was formerly the stern motor running at 125 revolutions per minute, is now running at 100 revolutions per minute. The propellers have the same speed characteristics, since they are directly connected to the motors. The electrical connections in the regulating rheostat are so made that whichever motor happens to be the bow motor for the time being will automatically run at 100 revolutions per minute. This method of driving the propeller is a radical departure from the method usually employed, in which the propellers are connected to a continuous shaft throughout the length of the ship and run at the same speed.

The Ward-Leonard system of control is used on both the turbo and Diesel electric types of vessels here on San Francisco Bay; that is, the change in speed of the propulsion motors is obtained by varying the excitation on the main generator. Decreasing the excitation on the generator decreases the voltage applied to the motors, thereby reducing the speed; increasing the excitation increases the speed. The motor field resistor bank consists of two parts—the permanent resistor and the speeding-up resistor. The permanent resistor is a bank of resistance which is always in the field circuit. With only this resistance in, the field current is quite high, which slows down the motor and, under normal operation, will run at 100 revolutions per minute. If the speeding-up resistance be cut in, the field current is diminished, thus decreasing the excitation on the motor, and it speeds up to 125 revolutions per minute under normal operation. This is the method used in obtaining the difference in speed between the bow and stern propellers. This regulation of the field current is done automatically by the controlling rheostat, and, in fact, the whole control of the speed of the motors, as well as reversing their direction of rotation, is obtained by the engineer by the one main controlling rheostat— a simple and very effective means. Communication between the bridge and engine room is effected by means of the usual type of ship's mechanical telegraph.

The record of the electric boats on San Francisco Bay has been very good. All of them have the direct-current installation, which has more flexibility than those fitted with the alternating-current installation and all of them have given satisfactory service.

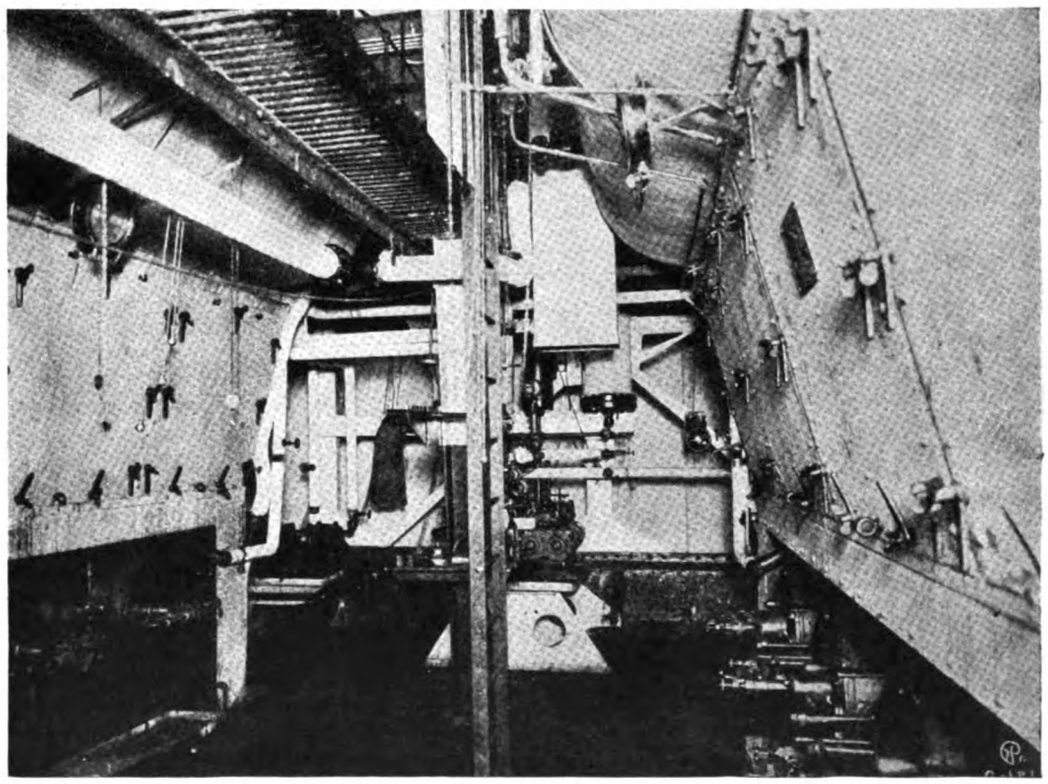

Fig. 3.— Athwartship view in fire room of S. S. Hayward before installation of forced draft blowers

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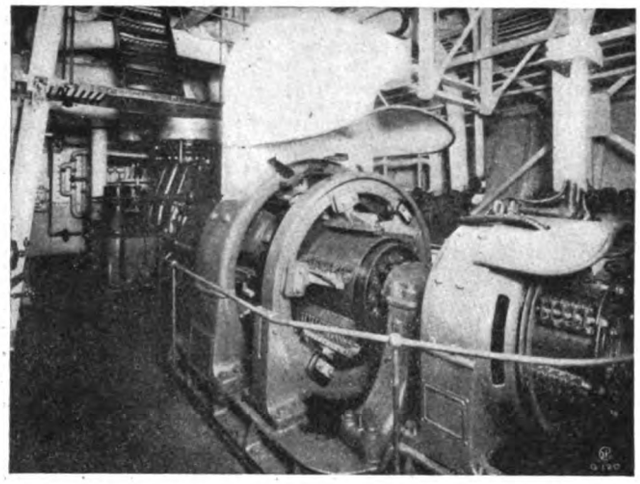

Fig. 4.—Turbine, generator and exciter of S. S. Hayward

DIESEL ELECTRIC DRIVE WITH MOTORS AT EACH END

The controversy as to the relative merits of steam and internal combustion machinery for ferryboats is a complicated one and by no means so easy of solution as partisans on both sides of the question would have one believe. The present cost and weight of Diesel engines have been considered prohibitive and their installation prevented by the fear of increased overhead charges involved. The pioneer company in adopting the Diesel electric drive in this vicinity is the Golden Gate Ferry Company. This type of installation has been put in their boats *Golden Gate, Golden West* and *Golden State.* The power plant on the first two consists of two Diesel engines of 525 brake horsepower apiece, built by the Pacific Diesel Engine Company of Oakland, of the Werkspoor type. Each engine is direct connected to generators, one large one of 1,440 amperes and an exciter of 304 amperes. The Diesels are set for 225 revolutions per minute. The main driving motor is direct connected to the propeller and is rated at 1,220 amperes, 145 to 180 revolutions per minute, 500 volts and 750 horsepower. All this electrical apparatus is from the General Electric Company.

The Diesel engines are of the six-cylinder stationary type; the usual marine type is not needed, as the engine is never required to reverse. The fuel oil pumps are of the suction valve regulation type; there is one plunger for each working cylinder. An overspeed flyball governor controls the engine and is completely enclosed in a case adjacent to the fuel pumps upon which it works, raising the section valves of the pump when the load is thrown off. On these particular installations, due to the fact that once every half-hour or so the full load is thrown off entirely within a very short interval of time, it was found necessary to provide, in conjunction with the usual flyball governor, an electric solenoid which is automatically energized the moment the load starts to decrease. This works upon the suction valves as the regular governor does, but is much quicker in its action and somewhat more sensitive. This improvement has done away with the former tendency of the Diesel engine to race when the load was thrown off when coming into the slipway. Even with this double governor system, however, the instant full load is thrown off the electric lights show it by a slight change in brilliancy, lasting only a few seconds.

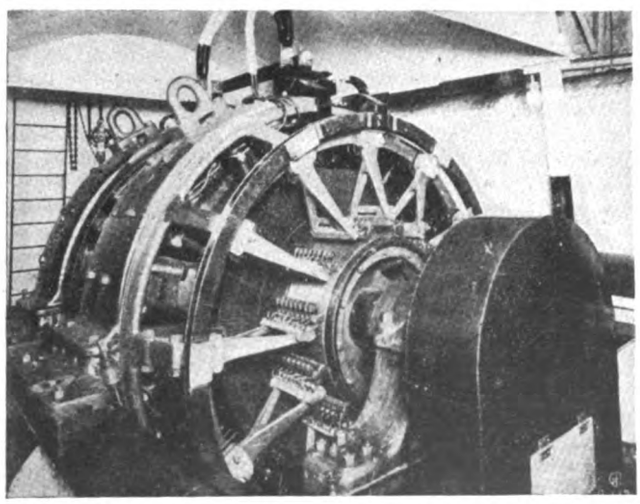

Fig. 5.—Double armature motor as located in each motor room, S. S. Hayward

Each of the two main generators for supplying the current to the propelling motors is shunt wound and rated at 360 kilowatts and 250 volts. Normally both generators in series supply current at 500 volts to the two motor armatures which are connected in parallel. The full load armature current is 1,440 amperes, and the field current is 36 amperes. The main propelling motors are shunt wound and consist of two direct connected 750 horsepower 145 to 180 revolutions per minute and 500 volt units. The stern motor has a full load armature current at 180 revolutions per minute of 1,220 amperes, and the field current at 180 revolutions per minute is 63 amperes; while that at 145 revolutions per minute is 90 amperes. This field current comes from the 115-volt supply from the exciter on the end of the Diesel engine shaft.

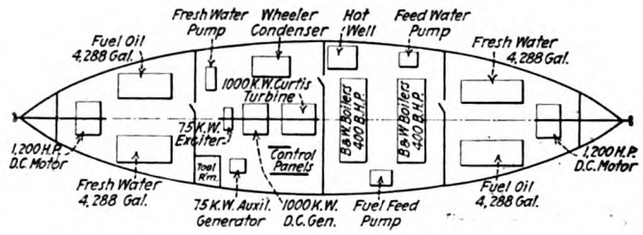

Fig. 6.—Arrangement of machinery in S. S. Hayward

The speed and direction of these boats are controlled entirely from the pilot house. This method of control on the Golden Gate ferries has been in continuous service for a period of four years up to July, 1926, and has given complete satisfaction. The idea is so well taken that the two new turbo-electric ferryboats for the Key System Transit Company are to have pilot-house control. The Ward-Leonard system is used as described for the turbo-electric boats, except that the control of the field rheostat for the generator field is done below on the old turbo-electric boats, whereas on the Diesel electric boat and the new Key boats this rheostat is placed topsides.

For a new ferry steamer which was recently proposed for service on San Francisco Bay the question arose as to what form of propulsion should be recommended to the Board of Directors. This new steamer was to be 286 feet length overall, 41 feet molded beam on the 10-foot waterline, 44 feet beam molded at the main deck and to be 72 feet over the guards. The displacement on the above draft was 1,410 tons. Various proposals of machinery arrangement were worked out, one such combination being shown in Figs. 7 and 8. The steam reciprocating power plant was designed for a through shaft installation. In the Diesel electric studies four high-speed engines were installed, and between the Diesel engines was installed the propelling motor for each end. This arrangement was desired, as it

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gave a long space at the end below the main deck for a restaurant. It will be observed that the length of the machinery space for the reciprocating installation is 68 feet, whereas for the Diesel-electric drive the machinery space occupied 82 feet of the length of the vessel, or a saving of 14 feet in favor of the steam reciprocating engine drive.

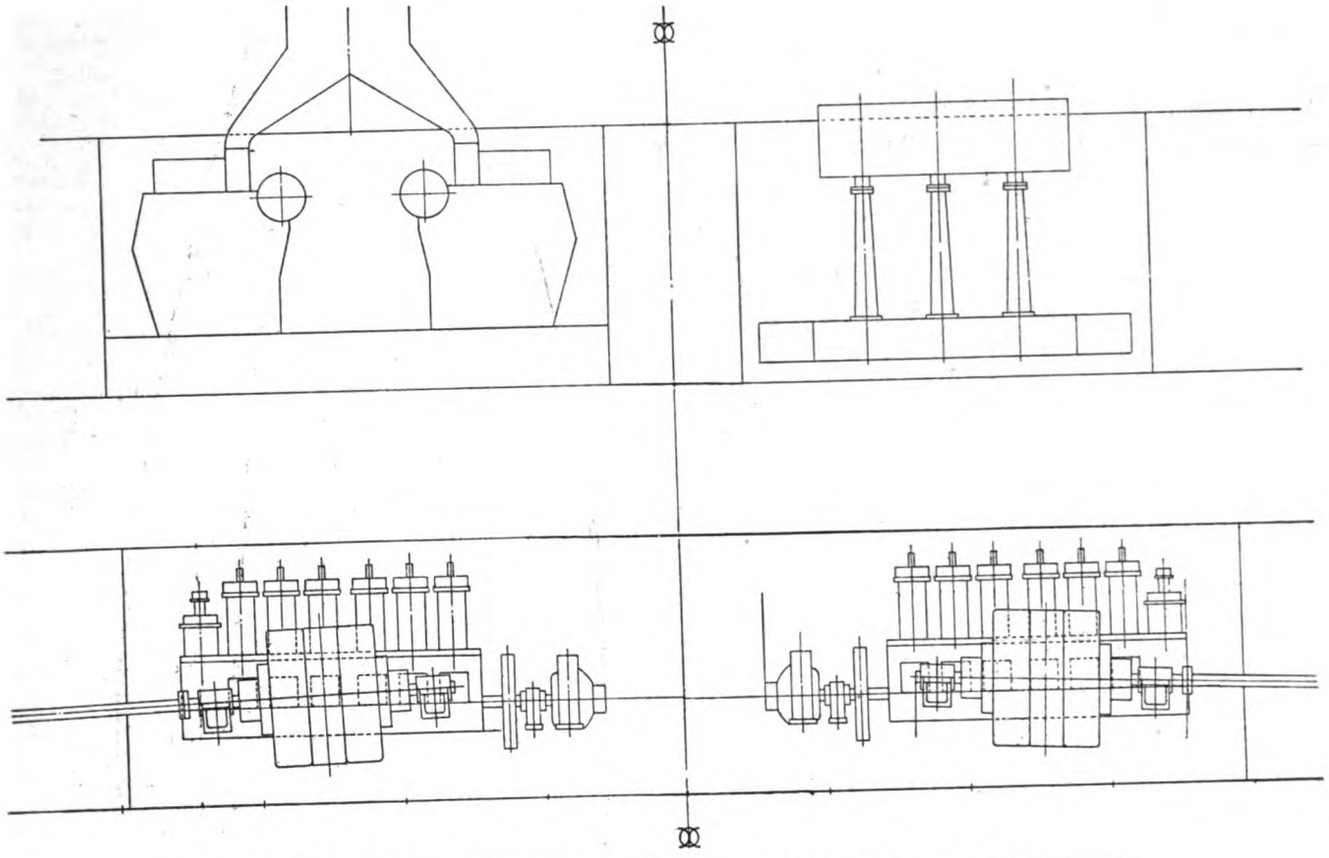

Fig. 7.—Comparison between motor and steam propulsion for a proposed ferryboat

Upper sketch shows typical reciprocating steam engine installation of 2400 indicated horsepower. Lower sketch shows typical Diesel electric drive of 2,000 shaft horsepower. Fuel tanks must necessarily be located elsewhere than in the machinery spaces here shown.

The comparative weight and cost of the various proposals are as follows:

Proposal	Weight, pounds	Cost
1 Triple-expansion engine, 4 watertube boilers and superheaters	722,400	$205,800
2 Four 600 B.H.P. McIntosh & Seymour and General Electric Co. equipment	1,018,000	317,900
3 Four 600 B.H.P. Pacific-Werkspoor and General Elec. Co. equipment	914,000	308,200
4 Four 600 B.H.P. Pacific-Werkspoor and Westinghouse equipment	937,000	320,900
5 Four 600 B.H.P. Busch-Sulzer and Westinghouse equipment	929,500	306,900
6 Four 600 B.H.P. Busch-Sulzer and General Elec. Co. equipment	906,200	294,900
7 Turbo-electric drive	757,000	.....

It will be noted that the Diesel installation is about 29 percent heavier than the steam expansion engine, the cost for the Diesel installation is about 50 percent more, and also the space occupied is more in the Diesel-electric installations.

COMPARISON OF TURBO-ELECTRIC AND PADDLE-BEAM ENGINE TYPES OF FERRIES

In a paper entitled "Electric Propulsion for Double-Ended Ferryboats" by A. Kennedy, Jr., and Frank V. Smith of the Marine Engineering Department of the General Electric Company, read before the Pacific Coast Convention of the American Institute of Electrical Engineers held in Seattle, Washington, during September, 1925, the advantages and operation of the electric drive on double-ended ferryboats were admirably presented. The general conclusions which were arrived at in that paper and reproduced by their permission are very significant and are as follows:

1. That the reciprocating steam engine or Diesel engine, in which the bow and stern propellers are operated at the same revolutions per minute, requires approximately 19 percent more power at the propeller shaft than the electric system, due to the difference in propulsive efficiency.
2. That the fuel consumption of the reciprocating steam engine drive with the direct-connected bow and stern propellers requires approximately 40 percent more fuel than the turbine-electric system, due to the difference in propulsive and thermal efficiency.
3. That the operating records of the boats in service prove electric drive to be reliable and a great step forward as a method of propulsion for the double-ended type of ferryboat.
4. That in comparison of turbo-direct current and alternating current types, the direct current is superior in flexibility, simplicity of control and general handiness afforded by bridge

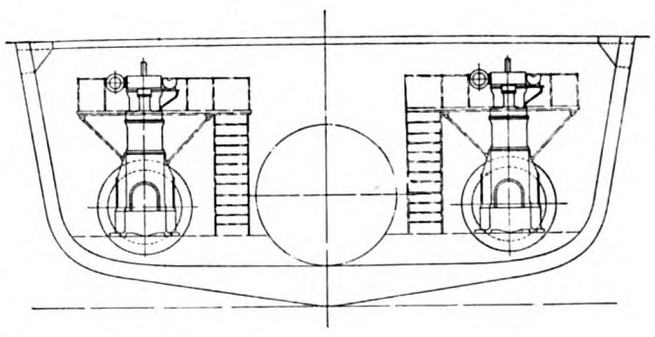

Fig. 8.—Section through machinery space of proposed ferry boat equipped with Diesel electric propulsion

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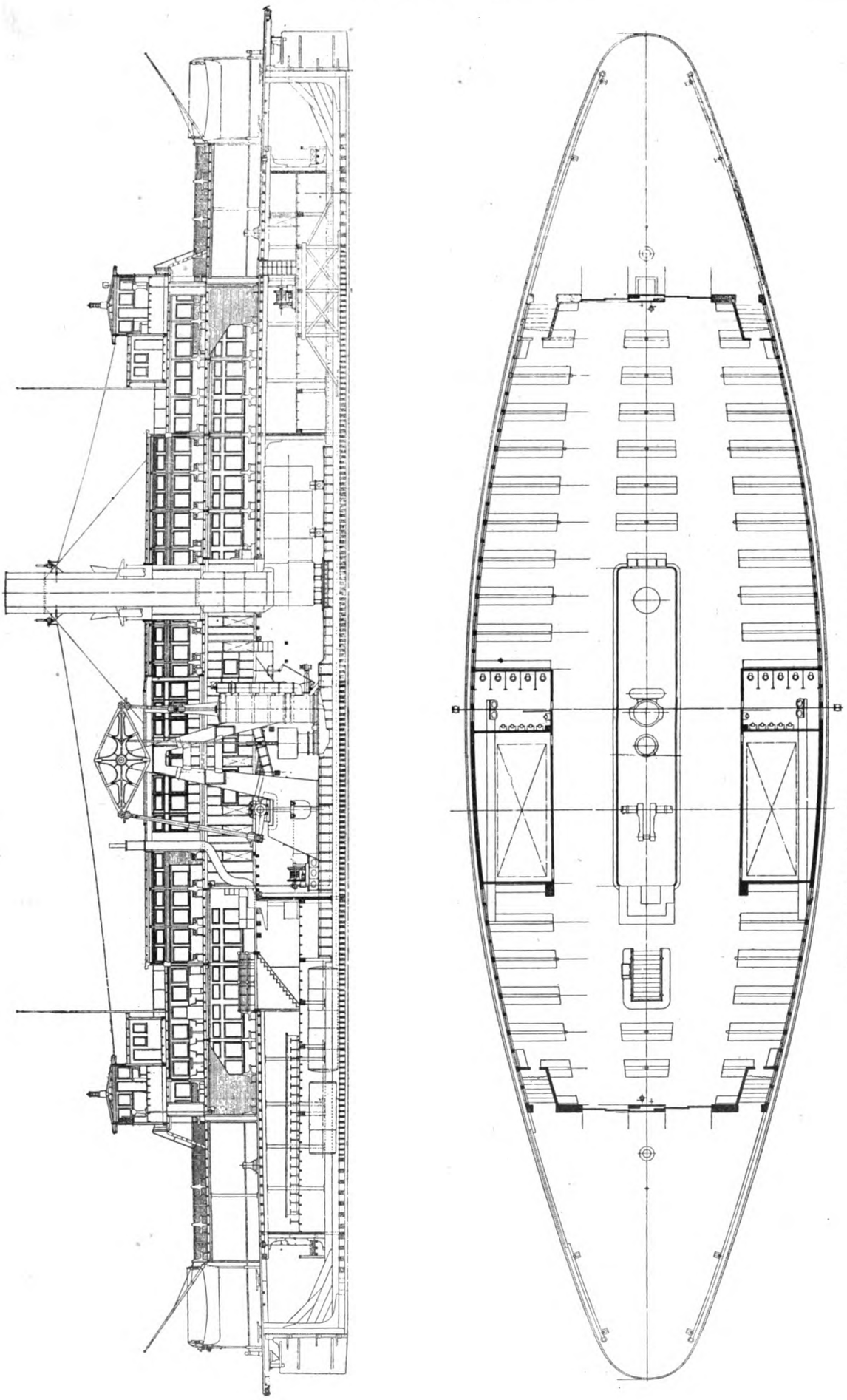

Fig. 9.—Inboard profile and main deck plan of S. S. Sacramento

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control. That the alternating current, however, is slightly more economical as regards fuel consumption.

5. That both turbo-electric and Diesel electric drive overcome the inherent propulsive efficiency loss of the reciprocating steam engine type of drive and that their respective spheres of application are dependent upon the relationship of first cost to operating charges and needs of service.

This proves conclusively that the electric drive has solved the problem as to flexibility of control, less fuel consumption and reliability when we consider only the screw propeller ferry.

It will be noticed that, in comparison number 2, the fuel consumption for a through shaft reciprocating engine drive is approximately 40 percent more than in the turbo-electric installation, and the profession may obtain the impression that no other type of drive is as economical as the turbo-electric drive. Such is not the case, as the following comparison will show.

The S. S. *Sacramento*, Fig. 1, is the largest passenger ferry steamer in the world and has the well known single cylinder vertical beam engine driving radial paddle wheels. The S. S. *Hayward* is a turbo-electric screw propeller boat, and the electrical machinery is described in an early part of this paper. Note the low fuel consumption on the beam engine boat which is using saturated steam. Much is self-evident regarding the low pressure and low vacuum (24 inches) which is used on the S. S. *Sacramento* as compared to a vessel using higher pressures and vacuum. One can vision what the fuel consumption would be if the *Sacramento* had been equipped with superheaters and a surface condenser. It will repay the readers to note the general arrangements of both of these vessels below their main deck. On the S. S. *Sacramento* there is room at one end below the main deck, Fig. 9, for a large restaurant, while on the S. S. *Hayward*, Fig. 10, the restaurant is on the main deck. The latter arrangement makes use of valuable deck space which otherwise might have been given over to additional seats. Note also the engine and boiler casings on the main and saloon decks, Figs. 9, 10 and 11, and the relative spaciousness on these two steamers. On the other hand the S. S. *Sacramento* is some 55 feet longer than the S. S. *Hayward*.

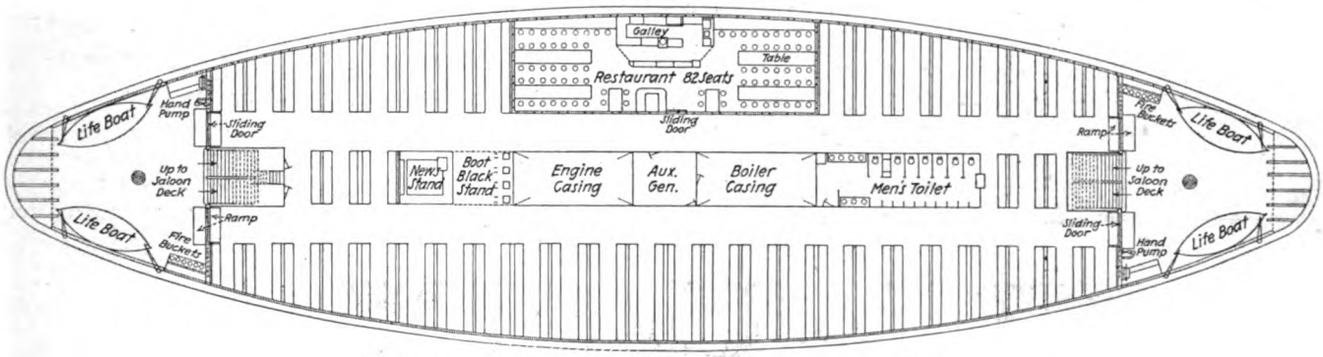

Fig. 10.—Main deck arrangement in S. S. Hayward

Type	Length B. P.	Length O. A.	Beam molded	Guards	Depth at center	Draft loaded	Displ. tons loaded	Built
S. S. *Hayward*.....Two screw prop., steel	225′ 0″	240′ 1″	42′ 0″	62′ 7″	19′ 6″	11′ 6″	1,653	1923
S. S. *Sacramento*.....Side wheel, wood.....	267′ 7″	295′ 1″	42′ 2″	78′ 0″	18′ 10″	9′ 4″	1,838	1923

Machinery	Boilers	Steam pressure	Superheat degrees	Heating surface, sq. ft.	Fuel cons. Lbs. per ton displ. per mile run
S. S. *Hayward*.....G. E. turbine, elec. drive.....2	B. & W. watertube.....	225 lbs.	65	5,000	0.105*
S. S. *Sacramento*.....Beam engine, 65″ x 12′..... 2	marine fire-tube 10′ x 29′ 6″ long	55 lbs.	0	9,040	0.107

* *San Leandro* (sister ship), 0.116.

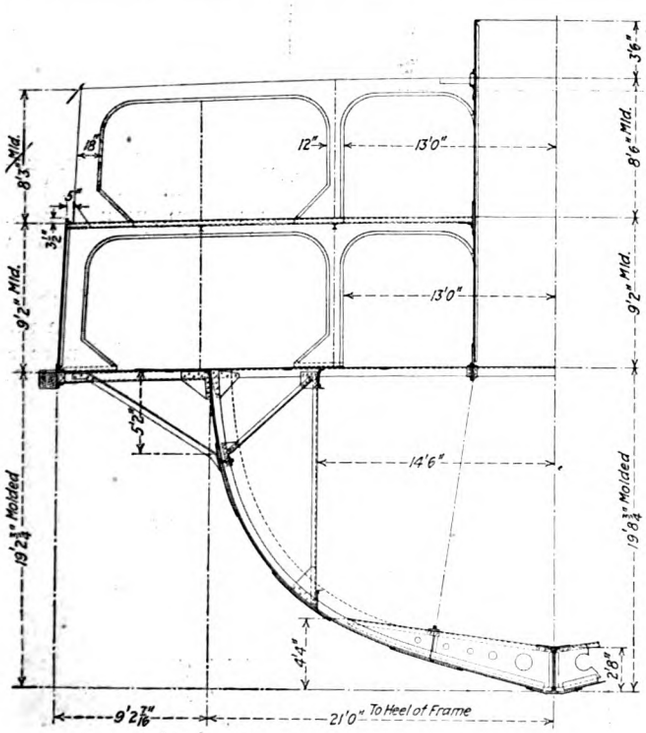

Fig. 11.—Midship section of the Hayward

The type of machinery as installed above brings up a very important point; namely, that the very first essential in a ferryboat as regards hull machinery or equipment is reliability. Economy which is obtained at the expense of reliability can have no place in marine practice.

A further comparison of the operating costs, as compiled by the Key System, of the turbo-electric propeller ferryboats *San Leandro* and *Hayward*, using superheated steam, with the Southern Pacific beam engine side-wheel ferryboat *Sacramento* using saturated steam, is as follows:

	Hayward	*San Leandro*	*Sacramento*
Gallons of fuel oil per 1,000 ton-miles...	16.78	17.19	16.09
Cost per 4,000 passengers per boat mile..	$2.48	$2.72	$2.44
Cost per 4,000 passengers for 2.85 miles.	$7.09	$7.75	$6.95
Cost per 1,000 ton-miles	$1.57	$1.72	$1.72

In obtaining the data upon which to base the performance of these boats, it was impossible to separate the actual run-

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ning time from the total steaming time; therefore a comparison on the basis of pounds of fuel per hour is not given and would be misleading, since a large percentage of the steaming time is spent in the slip. In the above table the figures for the Key Company's boats were taken for a five-month period and for the Southern Pacific steamer for a little less length of time.

Further Studies on Different Drives

As a further comparison on the many different drives we have in our waters on San Francisco Bay, the following compilation was made. Although the last column is the significant one here, it does not tell the whole story, as there is something more than fuel consumption alone.

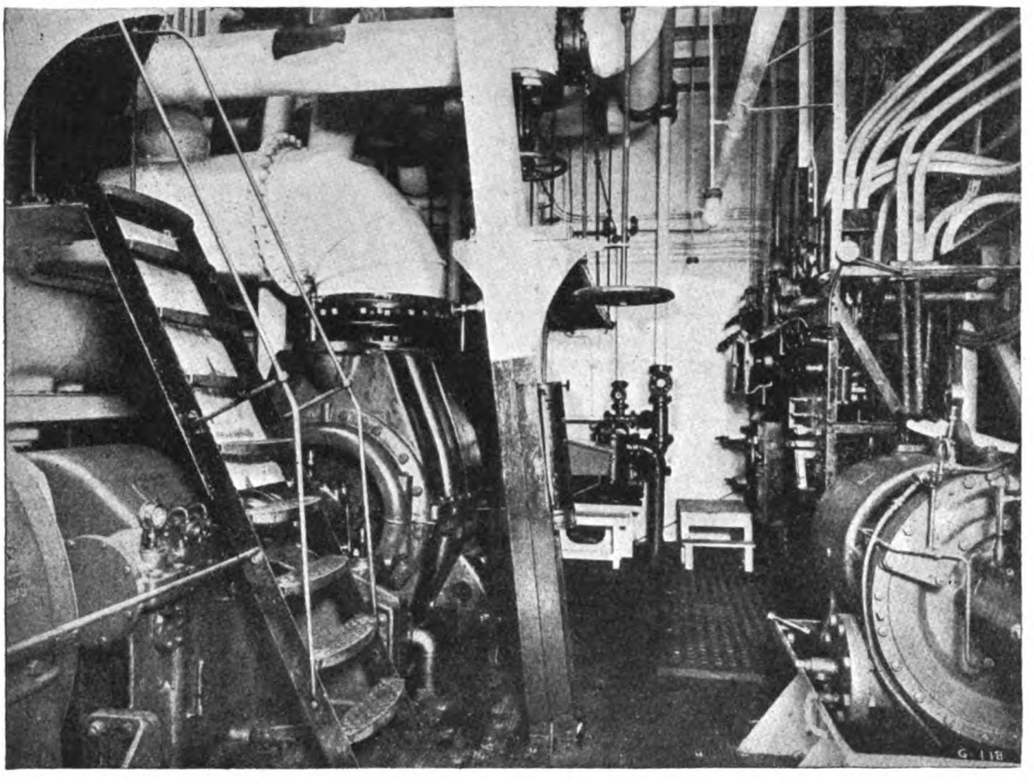

Fig. 12.— Turbine and switchboard in engine room of S. S. Hayward

Stability

The United States Steamboat Inspection Service requires all passenger vessels over 500 gross tons to be subjected to an inclining test in order to determine their metacentric height in the light condition. They have set as a minimum the value of 30 inches for these vessels' metacentric height. Ferry steamers could not in their original design meet this requirement. It resulted in the placing of permanent ballast in the bottom between the floors ranging in weight from 2 to 65 tons, certainly a reflection in design which should not be passed over, as some vessels have 4.5 GM in their light condition. By proper design a large GM in the light condition can be anticipated which will nullify all the anxiety when the vessel is being inclined for the first time. Considering the type of cargo which is carried by ferry steamers, we do not think that a GM of 5 feet is too high to recommend for a ferry steamer in the light condition.

Materials Used and Construction

In some of the vessels steel has been used for the lower hull, while for the superstructure and inside partition wood has been used entirely. In other vessels wood has been used throughout, and in vessels now under construction for the Key System Transit Company the hulls and superstructure are to be entirely of steel. No doubt an all-steel boat has many advantages as to ease in upkeep, fireproofness, and can be made watertight, although such a boat is much heavier and the initial cost is more.

With steel construction the transverse system of framing is used reinforced with several little side stringers. On the bottom several keelsons are used, which in addition to a center line keelson and deck girders, give the vessel suffi-

SOME CONSIDERATIONS IN DESIGN OF FERRYBOATS

Name	Type	Length O. A	Beam molded	Grds.	Draft loaded	Displ. loaded	I.H.P.	Engines Diesel electric	Fuel, lbs. per ton displ. per mile run Bldg. (?)
Golden State	Screw auto and pass..	240′ 0″	44′ 0″	60′ 0″	11′ 9″	1,115	3—400 B.H.P. Diesels.	Turbo-electric	0.105
Hayward	Screw pass.	240′ 1″	42′ 0″	62′ 7″	11′ 6″	1,653	1—1,200 S.H.P. turbine	Turbo-electric	0.116
San Leandro	Screw pass.	240′ 1″	42′ 0″	62′ 7″	11′ 6″	1,653	1—1,200 S.H.P. turbine	Two 20″, 42″x28″	0.242
Fernwood	2 comp. engines screw pass.	200′ 0″	42′ 0″	.....	13′ 4″	1,060	1,700 at 120 R.P.M...	Diesel electric	0.039
Golden Gate	Screw auto and pass..	220′ 0″	37′ 0″	60′ 6″	10′ 6″	1,030	2—525 B.H.P. Diesels.	Diesel electric	0.032
Golden West	Screw auto and pass..	220′ 0″	37′ 0″	60′ 6″	10′ 6″	1,030	2—525 B.H.P. Diesels.	Single incl. 57″x14′ 0″	0.149
Piedmont	Incl. beam pass. paddle	273′ 2″	38′ 10″	74′ 1″	8′ 7″	1,536	1,380 at 21 R.P.M....	Beam 65″x12′ 0″	0.107
Sacramento	Side-wheel pass.	295′ 1″	42′ 2″	78′ 0″	9′ 4″	1,838	1,350 at 19 R.P.M....	Triple ex. 22″, 34″, 56″x36″	0.136
Berkeley	Screw pass.	279′ 0″	40′ 0″	64′ 0″	10′ 3″	1,565	1,310 at 126 R.P.M...	Triple ex. 19″, 32″, 54″x36″	0.121
San Mateo	Screw auto and pass..	230′ 0″	42′ 0″	63′ 6″	13′ 0″	1,429	1,230 at 106 R.P.M...	2 incl. dbl. tam. comp. 20″, 40″x8′ 0″	0.179
Alameda	Side-wheel pass.	293′ 0″	42′ 0″	76′ 0″	9′ 6″	1,819	1,845 at 24 R.P.M....	Beam 65″x12′ 0″	0.109
Eureka	Side-wheel pass.	300′ 0″	42′ 0″	78′ 0″	8′ 2¾″	1,742	1,260 at 20 R.P.M....	Turbo-elec.	Bldg (?)
Two new Key boats..	Screw pass.	276′ 0″	47′ 0″	70′ 0″	14′ 9½″	2,015	2,250 S.H.P. turbine..		

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cient longitudinal strength. The steel vessels are built without any double bottom.

An innovation in ferry steamer construction has been incorporated in the new vessels for the Key System Transit Company. The braces which ordinarily support the overhang of the vessel at the sides have been dispensed with and in their place a sponson has been incorporated to take this support and at the same time offer additional buoyancy in case the vessel should become bodily immersed in the water. This plating on the sponsons has been carried inboard to meet the longitudinal bulkheads. In other words, the bilges and sides of the vessel have been protected, as there is greater probability of the ferryboat meeting another vessel than of her going aground.

A new form of keel has also been incorporated into these new boats. It is of the box type, and all protrudes outside the normal contour of the bottom of the vessel. The reason given for this construction is that it assists the ferry when going into a slipway, especially when there is a strong rip tide flowing across the end of the slip while in the slipway there is comparatively slack water.

PROPELLERS AND STERN TUBES

Owing to the relatively small draft that the ferries operate upon, the diameter of the propeller wheels must accordingly be small in order to get sufficient submergence of the wheel. Four-bladed wheels are wholly used. In most cases the lower support of the rudder has been dispensed with, the rudder being hung from an upper pintle; the shape of the rudder is of the balanced type. In new boats now under construction the arrangement will be such that both bow and stern rudders may be used from either pilot house. This will insure greater maneuverability when coming into the slipway. On several of the boats there were originally installed built-up bronze wheels, but these were replaced by cast steel solid wheels, and recently stainless steel wheels have been put on. This, we think, is the first time this material has been used for propellers, and of course we are awaiting the first docking of that particular vessel to see whether the steel will stand up any better than the cast steel, cast iron or bronze wheels which were all subject to pitting. The composition of these stainless steel wheels is as follows: carbon 0.33 percent, chromium 6.6 percent, and nickel 20 percent. The tensile stress is accordingly higher, being in the neighborhood of 79,600 pounds per square inch. Some of the badly pitted blades were removed, the pitted places chipped, welded material was placed in the holes, dressed smooth and then put back on the vessel. Whether this is the proper solution for the evil of cavitation we cannot say, as the vessel has not been docked since the welded blades were put back.

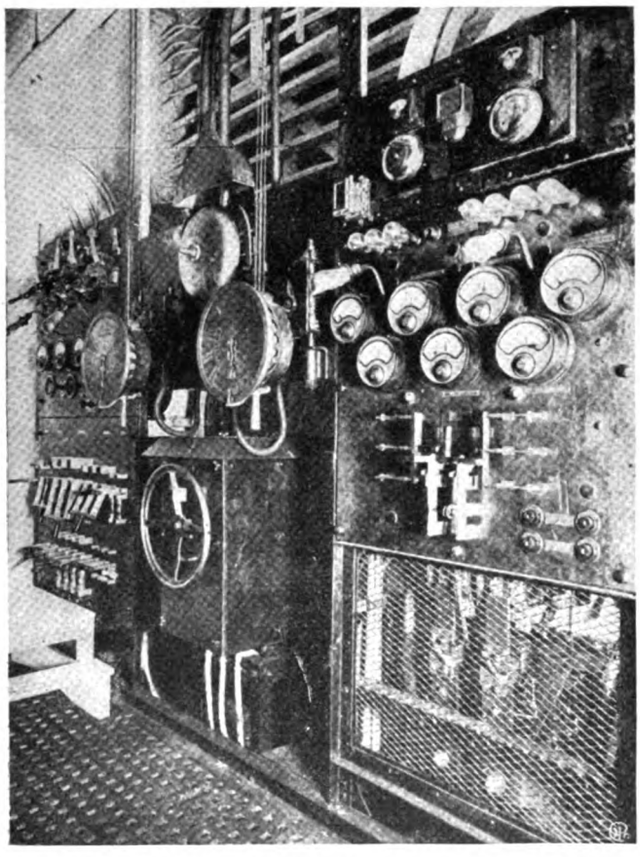

Fig. 13.—Switchboard, showing maneuvering wheel, S. S. Hayward

An interesting feature on one of the vessels is the use of the Goodrich cutless rubber bearing, which is used for the stern bearing in place of the customary lignum vitæ. The diameter of the shaft is 9⅝ inches, and the lengths of the inboard and outboard bearings are each 2.25 feet. Formerly these bearings, when used on smaller installations, had the spiral water groove, but in the present vessel the water grooves are to be parallel to the axis of the shaft.

CONCLUSIONS

Summing up the question of the selection of the main propelling machinery for a ferryboat, the following conclusions may be drawn:

1. That the straight through shaft propeller drive for ferries requires considerable more power than the Diesel or turbo-electric system.
2. As for flexibility and remote control there is nothing that can surpass the Diesel or turbo-electric drives.
3. That the fuel consumption on a side-wheel paddle ferryboat is about the same or a little lower than the turbo-electric boat.
4. That the initial costs of the walking beam paddle wheel steamer and the steam reciprocating engine installation are less than the turbo-electric or Diesel electric installations.
5. The lowest fuel consumption is that of the Diesel-electric system, but its drawback is the initial cost and the excessive weight.

A Kink

By G. W. Stutt

IN raising steam on a battery of four Scotch boilers, I found I had a top manhole plate leaking so badly that I could not set up on it. As I was limited for time I wondered what I could do and finally thought that the main air pump was the solution of my troubles.

I started the main air pump and circulating pump, opened the main stop valve and throttle valve on the main engine, went back on top of the boiler and found that enough vacuum had formed to stop the leak.

I then got a new gasket and had no difficulty in taking the plate out and renewing the gasket. I had steam up with the other boilers without forcing this boiler.

This was a coal burner and all that was necessary was to cover the fires with coal.

CARGO SHIPPED THROUGH PANAMA CANAL.—The total quantity of cargo shipped through the Panama Canal in the year 1926, was 27,586,051 long tons. This was an increase of 16.4 percent over the cargo tonnage for the preceding calendar year and was the largest for any 12-month period since the opening of the Canal to traffic. The previous high record was 26,994,710 tons, in 1924.

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Shipping Board Finds Subsidy Necessary

Report to the Senate shows sentiment throughout the country unanimously in favor of an adequate merchant marine privately owned and operated

By Harold F. Lane

WASHINGTON, D. C.

THE Shipping Board, in its report to the Senate on January 12, in reply to Senate Resolution No. 262, says that the board is convinced that "without additional legislation for direct or indirect federal aid commonly called subsidy a privately owned and operated American merchant marine for our foreign commerce cannot be successfully established." The board is also convinced that "with appropriations necessary for the continued operation of approved essential routes and authority for a replacement and improvement-construction-program necessary to meet subsidized foreign competition this board can establish an economical and efficient government-owned and operated merchant marine. Without a definite program of this character government operation can not be made satisfactory."

In preparing this report the board has made use of the vast amount of data on comparative costs of construction at home and in foreign countries, ship operation under various national flags, food expense, wages and working conditions, repairs, depreciation, insurance, overhead expenses, interest rates, etc., collected during the past six years of the board's administration of the merchant marine act and the experience of the board gained during that time.

Public hearings were conducted by the several commissioners of the board in thirty-three cities. The recommendations and suggestions made by those who attended these hearings and responses to nine thousand inquiries addressed by the board to representative organizations and individuals throughout the country for the purpose of recording current sentiment and suggestions are summarized in the report as follows:

(1) It was unanimously held that the United States should have an adequate merchant marine for national defense and for commerce.

(2) With almost equal unanimity, it was held that this merchant marine should be privately owned.

(3) With equal unanimity it was held that until it is made possible for private interests to successfully own and operate the American merchant marine the federal government must continue to do so.

The reasons cited by the board for its conclusions are:

It should not be possible for our foreign competitors to quote from our merchant marine act designed to keep in view the primary end of a permanent merchant marine such expressions as "or unless it shall appear within a reasonable time that such line can not be made self-sustaining" (Sec. 7, M. M. Act, 1920), which they are now so effectively doing to create the impression that it is not the intention of our government to support a merchant marine unless it prove self-sustaining in competition with foreign subsidized services, although such interpretation of this language may not be warranted when read in conjunction with the general purposes and scope of the act.

The very name of the United States Shipping Board's operating agency designated as an "Emergency Fleet Corporation" might well be changed to indicate more permanence than an emergency.

A definite plan for permanence is vital and would silence foreign competitors from effectively predicting the unreliability of an American merchant marine and impress them with the futility of destructive rates and unfair methods so long practiced by them to the disadvantage of ships of American registry.

In line with the mandate of Congress that the board shall have in view the transportation of "the greater portion of its (our country's) commerce" M. M. Act, 1920, Sec. 1, the following scheduled cargo services now being operated through agencies of the board are of sufficient national importance to justify continuation and development:

America France Line	North Atlantic ports to Havre, Dunkirk, Bordeaux and St. Nazaire.
American Australia Orient Line	Pacific Coast ports to Australia, New Zealand, China, Japan, Philippine Islands and Straits Settlements.
American Diamond Line	North Atlantic ports to Rotterdam and Antwerp.
American Dixie Line	New Orleans and Texas ports to United Kingdom and Irish ports.
American India Line	North Atlantic ports to Indian ports.
American Merchant Lines	North Atlantic ports to East Coast of United Kingdom ports.
American Oriental Mail Line	Puget Sound ports on Pacific Coast to China, Japan, and Philippine Islands.
American Palmetto Line	South Atlantic ports to United Kingdom and Continental European ports.
American Pioneer Line	North Atlantic ports and Gulf ports to China, Japan, Philippine Islands and Dutch East Indies.
American Premier Line	Gulf and South Atlantic ports to French Mediterranean, West Coast of Italy, Greece, Levant and North Africa (East of Bizerta).
American Republics Line	North and South Atlantic ports to East Coast of South America.
American Scantic Line	North Atlantic ports to Scandinavian and Baltic ports.
American West African Line	North Atlantic and Gulf ports to West Coast of Africa, including Azores, Canary and Madeira Islands.
Atlantic Australian Line	New York to Australian ports.
Gulf Brazil River Plate Line	Gulf ports to East Coast of South America.
Gulf West Mediterranean Line	Gulf and South Atlantic ports to Portuguese, Spanish, and North African ports (West of Bizerta).
Mississippi Valley-European Line	New Orleans to Havre, Antwerp and Ghent.
Mobile Oceanic Line	Mobile and Eastern Gulf ports to United Kingdom and Continental European ports.
Oregon Oriental Line	Columbia River ports on Pacific Coast to China, Japan, and Philippine Islands.
Oriole Lines	North Atlantic ports to West Coast of United Kingdom and Irish ports.
Southern States Line	New Orleans and Texas ports to Bremen, Hamburg and Rotterdam.
Texas Star Line	Texas ports to Havre, Antwerp, Ghent and Rotterdam.
Yankee Line	North Atlantic ports (excluding New York) to Bremen and Hamburg.

These twenty-three services remain after all sales possible into private hands have been made and all consolidations to date of some 80 lines formerly operated by the board. The net cost of these cargo services for the fiscal year ending June 30, 1926, was $16,300,000. This record of cost may be taken as a guide for determining the aid needed in the immediate future for continuation of these cargo services. No charges are included in these figures for interest or depreciation, charges which a private owner would, of course, be compelled to meet.

The lines which were established by the United States Shipping Board and then either sold to private American owners or which were privately owned and have been augmented by vessels purchased from the board should be continued and further developed. The aid they will require for renewals and replacements demands early consideration.

The United States Lines, operated by the board through the Emergency Fleet Corporation, is the only fast passenger service carrying our government's flag across the North Atlantic.

The board's recent advertisements of this line for charter or sale requiring continued operation brought no bid for its purchase.

The board is convinced that this line, with its peculiar value as an element of national defense and for broadening the scope of national commercial relations, should be maintained and developed and that the government must under the circumstances continue its operation for the present.

The line as now constituted of the *Leviathan*, the *George Washington*, the *President Harding*, the *President Roosevelt* and *Republic* is unbalanced and, therefore, is at a great disadvantage in its attempt to meet the competition of formidable foreign flag lines already intrenched in this service. Experience

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has proven that if this initial step is to succeed, it must be expanded to the normal proportion of a balanced transatlantic fleet.

In connection with the preceding statement of services required to meet commercial needs it is pointed out that the minimum requirements of the Post Office Department for ocean mail service are substantially as follows:

1. Weekly sailings from New York to Northern European (Scandinavian) ports.
2. At least semi-weekly sailings from New York for British, French and German ports.
3. Weekly sailings from New York to the Mediterranean, touching at important points on both North and South shores.
4. At least bi-weekly sailings from New York to Constantinople and Black Sea ports.
5. At least bi-weekly sailings from New York to West, South and East African and Indian ports.
6. Weekly sailings from New York to the East Coast of South America and as far as Montevideo and Buenos Aires.
7. Weekly sailings from New York to the West Coast of South America as far as Santiago.
8. Weekly sailings from New York to the Canal Zone via Havana.
9. Weekly sailings from New York to the more important Islands of the West Indies.
10. Weekly sailings from New Orleans, through the Panama Canal, to West Coast ports of Central America and Mexico.
11. Bi-weekly sailings from San Francisco to New Zealand and Australia.
12. Weekly sailings from San Francisco, via Honolulu, Yokohama, Shanghai, Hongkong and Manila, to Singapore.
13. Weekly sailings from Seattle to Yokohama, Shanghai, Hongkong, and Manila.

Practically all of these would be main or trunk lines which would be connected at various points with auxiliary or feeder lines which would not necessarily be of American registry.

The vessels on these mail carrying trunk lines should be at least equal in speed to those of any possible competitor on the routes indicated, so that our mails may not be delayed, nor our commerce penalized by patronizing American registry ships.

During the last five years the speed of cargo vessels has materially increased. While vessels of 9 to 12 knots were usable and numerous in the past, the cargo liner of today for long voyages on important competitive routes is designed for speeds of 12 to 14 knots and many up-to-date motor cargo liners make 15 knots.

The development of the modern motorship marks a revolution in marine propulsion and establishes unquestionable advantage of the internal combustion engine for long voyages. Quantity production of these more effective and more economical engines will naturally reduce cost until they will become in general use for ships on shorter voyages.

In the meantime the information being obtained from the twelve sets of internal combustion engines purchased in accordance with the act of June 6, 1924, will afford the technical data necessary for the development in our country of this type of improved ship.

Whether the government continues the operation of merchant ships or conditions are created under which private owners can take control of the transportation of our ocean commerce, it is manifest that ships are required designed for the particular services in which they must compete.

The fact that since our great competitors have again become able to develop superior ocean services our business with South America has been seriously affected, and will of course be further invaded as these foreign services are augmented unless ships of our country's flag are produced, able to meet modern requirements, readily demonstrates that a program of improved services should be undertaken.

Our competitors are also putting fast modern freight ships into trade with the Orient, a commerce of great importance which can not be developed and held for our country without a comparable merchant marine under our country's flag.

A replacement and improvement program is an essential feature of any plan for a permanent merchant marine. Our foreign competitors are already well on their way in this direction.

If Congress makes possible a privately owned and operated, permanent, merchant marine, renewals and improvements will become automatic through the self-interest of purchasers and owners, modernizing their own fleets.

If the government is to continue the operation of merchant ships the plan now in force of direct operation by the board and managing agency agreements under board supervision, with such changes as conditions and future experience suggest, should be followed.

Section 24 of the Merchant Marine Act of 1920 makes possible assistance for mail lines.

However, the amount to be paid under certain conditions would be so large and appropriations from year to year so indefinite that private capital hesitates at the uncertainty.

An adequate and permanent American merchant marine privately owned and operated can be built up and maintained by fundamental aid, available for freighters as well as mail-liners, through long-time contracts authorized by Congress, sufficient to equalize the higher costs of both construction and operation imposed by our protective laws on ships of American registry. The Post Office Department to provide by mail contracts for no more than amounts sufficient to off-set the mail pay of competitive nations.

It is obvious that before private capital can be induced to undertake the construction and operation of American vessels to engage in the foreign trade of this country, there must be some certainty of the continuance of government aid during the reasonable life of the ships so built.

A method suggested is that all vessels, freight as well as passenger, entirely owned by Americans and flying the American flag, should receive under a contract authorized by Congress, continuing until such vessels attain the age of twenty years, a payment proportioned on speed and computed on the number of days at sea while carrying cargoes to and from the United States.

It is suggested that the reserve of American ships, regularly operating in coastwise or intercoastal trade would thus be in a position to leave such trades and enter our foreign trade, whenever foreign flag ships desert our commerce in their own national interest and thus threaten our agricultural surpluses as was done in 1924 and as again occurred in 1926. When such American flag ships enter our foreign trade, and only then, and for so long as they continue carrying cargoes in that trade would the equalizing aid be allowed.

Any definite plan for an American merchant marine must take into consideration comparative competitive costs of construction and operation.

The principal factors of the higher costs are construction, repairs, wages of ship's personnel and subsistence.

The differential handicap in these items, with the added fixed charges of interest, depreciation and insurance vary from 5 percent to 9 percent per annum of the capital cost of the American built ship, depending on the type and based on an average life of twenty years.

Further handicap of an American merchant marine is found in the uninterrupted experience enjoyed by our foreign competitors through the constant material assistance extended to them by their governments.

Our foreign flag competitors have valuable connections through ownership of property and established industries in foreign ports leading cargoes to their ships.

Equalizing benefits in some form and in volume sufficient to give reasonable assurance of success to practical shipping interests engaging in or entering into our country's overseas transportation under the American flag are manifestly necessary.

A comparatively few years of experience will be sufficient to establish American services on the oceans with minimum assistance.

A permanent merchant marine depends upon replacements and improvements and that inevitably leads to some new construction.

Earnest attempts have been made to dispose of the government's fleet to private interests with limited success.

However, a majority of these ships carrying our foreign trade continues to be operated by the United States Shipping Board or through agencies established by this board. In each case the ships are those of the original fleet and unless measures are taken to provide for replacements of these vessels as they become outclassed through depreciation or obsolescence, American ships in foreign trade will again vanish from the seas.

It must be remembered that these ships and the surplus ships in our laid-up fleet were constructed in and for an emergency and that while a certain number of them may well be used to augment slow services, provide relief in times of emergency and serve as "tramps" with which to regulate rates, not one of them is of the type of cargo-liner with which our skilled foreign competitors are increasingly outclassing us on the major trade routes.

To meet this already existing and increasingly superior foreign competition an American merchant marine of permanence will have to be supplied with some cargo-liner types of vessels of approximately 15 knots and 11,000 tons deadweight which do not exist in reserves of our laid-up fleet.

The board is convinced that the first essential for the building up and maintenance of an adequate merchant marine for commerce and national security is for the government to make it evident in no unmistakable manner that efficient ships of American registry shall permanently serve American needs on the approved American trade routes of the world.

Battleship Alterations Favored

The House committee on naval affairs on January 19 submitted to the House a favorable report on the bill to provide for alterations and repairs to the battleships *Oklahoma* and *Nevada* at a total cost of not to exceed $13,500,000.

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Questions and Answers for Operating Engineers

Practical information for marine engineers on the operation and maintenance of boilers, engines and auxiliaries

Ratio of Heating Surface to Grate Area

Q.—What is meant by the expression "Ratio of heating to grate surface?"

A.—This is merely a relation used in comparing one boiler with another. It is for any boiler the number of square feet of heating surface per square foot of grate surface.

Action of Injector

Q.—How is it an injector forces water into a boiler when the pressures on the boiler and the injector are equal?

A.—The velocity of the steam coming in contact with the water gives it the energy necessary to overcome the pressure.

Valves to Be Left Open When Raising Steam

Q.—What valves should be left open when starting fires in a boiler to raise steam?

A.—The safety valves, valve to steam gage, pet cock on steam gage, water column valves, and air cock on top of boiler.

Causes of Trouble with Feed Pumps

Q.—What generally causes trouble with feed pumps?

A.—Loose pistons. The float in the hot well out of order. Water becoming too hot or insufficient water. Something getting under valves, or the valve in the steam end shifting.

Care of Turbine at End of Run

Q.—What are the most important things to look after at the end of each run in regard to the turbine?

A.—Take clearances on all bearings and thrusts and compare these readings with those taken on the last voyage.

All lubricating oil that has been in operation should be heated and run through the lubricating oil separator.

Both lubricating oil pumps should be thoroughly examined and overhauled if necessary, as well as all other auxiliaries. Look especially for possible air leaks.

Starting Up a Turbine

Q.—What care should be taken in warming or starting up a turbine?

A.—Start the lubricating oil pump; make sure that all bearings are getting oil by trying test cocks or sight flow feeds.

In warming up it is absolutely necessary that all parts expand uniformly. This can be accomplished only when the rotors are moving, in order that steam may come in contact with all parts. In no case should the rotors be allowed to stand idle while warming up, as local distortions are likely to take place.

Put steam on the seals for the main turbines in order to obtain a vacuum. Start the main circulator, condensate pump and air ejector or radojet.

While warming up, a low vacuum should be maintained, just enough to keep the turbine clear of water and permit steam to be evenly distributed.

Never turn the auxiliary exhaust into the turbine until "all clear of pilot." When "standing by" the turbine should be turned a few revolutions every 20 minutes.

Evaporation Per Pound of Coal

Q.—Define the expression "evaporation per pound of coal."

A.—This is a rough measure of boiler efficiency. It is the number of pounds of water evaporated into steam per pound of coal burned on the grates or per pound of oil forced into the furnace. This figure may run from 6 to 11 with coal and from 12 to 16 with oil.

Care of Steam Auxiliaries

Q.—How often should steam auxiliaries not in frequent use be tested?

A.—The instructions of the Bureau of Engineering, Navy Department, require that auxiliary steam machinery not in frequent use shall be moved by hand every day, when possible, and by steam at least once a week.

Tests of Holding-Down Bolts

Q.—Is there any recognized practice as to testing or examining holding-down bolts, chocking or other means of securing engines, boilers, etc.?

A.—In the naval service all holding-down bolts, chocks and ties fitted for securing in place engines, boilers or other machinery parts are examined frequently as to their condition. At least once every three months they are tested by sounding or other suitable means.

Precautions Against Freezing in Machinery Containing Water

Q.—What precautions against damage due to freezing are taken relative to boilers and machinery containing water?

A.—Presumably this question relates to vessels in active service, in which case every effort should be made to maintain the temperature of the compartments containing such apparatus above 40 degrees F.

Inspection of Engine Cylinders

Q.—What can be said of the inspection and care of the cylinders of reciprocating engines?

A.—Accepted naval practice requires that as soon as practicable after each run, the cylinders of main engines of the reciprocating type should be opened and dried out. Then, unless it is expected that the engine will be run again within three days, the cylinder walls should be covered with a thin coating of vaseline or cylinder oil. Similar procedure should be followed whenever, for any other reason, the cylinders are opened. Whenever cylinders are opened all air inlets, drains, indicator connections, etc., through which air might be admitted, should be kept tightly closed during the period of idleness.

After each run during which main reciprocating engines have been operated at or above two-thirds of their designed full power, also at intervals of not more than 30 steaming days when worked at lower powers, the interiors of cylinders and the piston nuts, rings, springs, followers, and follower bolts, should be examined.

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Why Crank Shafts Break

Q.—What are some of the reasons that cause a crank shaft to break?

A.—Flaws in material used, hot bearings or the engine getting out of line.

Drilled Screw Staybolts

Q.—What is the reason for fitting the drilled screw staybolt in boilers?

A.—The expansion and contraction in the boiler plates sets up bending stresses in the staybolts of greatest intensity near the heavier plate. If the bolt fails under these stresses or as the result of corrosion, the resulting leakage of steam or water will be at once apparent, so that repairs can be promptly undertaken.

Repairing Small Cracks in Boiler Plate

Q.—How may small cracks in a boiler plate be best repaired?

A.—A hole may be drilled at each end of the crack to stop its extension. Then a patch may be fitted, suited to the individual condition. Very small isolated holes or cracks may be drilled and tapped, then filled with soft iron or steel bolts riveted down so as to completely close the crack.

Advantages of Hollow Cylindrical Members in Engine Construction

Q.—What are the advantages, other than weight saving, which result from the use of hollow cylindrical members in engine construction?

A.—The member is stronger for a given weight. The central core of the metal is removed. This part is more likely to contain flaws which might extend to the remaining metal during service, so its removal is a safeguard. The hole gives opportunity for inspection.

Hard Patch

Q.—What is a hard patch in boiler repair work?

A.—A hard patch is one which is made to a heating surface and intended to be of a permanent nature. In order to avoid the thickening of the metal in the heating surface so far as possible, the broken or inferior material is first cut out and a doubler of the smallest possible extent riveted up as in regular boiler work.

Rivet Holes in Scotch Boilers

Q.—In a Scotch boiler are the rivet holes punched or drilled and why?

A.—Present practice is to drill rivet holes and remove any burr by reaming. The drilled hole is superior to the punched hole because it may be located more accurately and with less damage to the material in the boiler plate with which it is immediately surrounded.

The Hydrometer

Q.—What principles are utilized in the hydrometer?

A.—When a body floats freely either partly or fully immersed in a liquid, the weight of that body is equal to that of the liquid displaced. The hydrometer is based upon this principle. It may be constructed either of glass or metal. It consists of a stem on which are fitted two bulbs. The upper and larger bulb is filled with air and furnishes adequate buoyancy. The lower and smaller bulb is weighted so as to maintain the instrument upright when floating without restraint. The upper portion of the stem is graduated so as to indicate the depth of immersion. The hydrometer is used to determine the density of liquids. The denser the liquid in which placed, the higher the instrument floats.

Smokeless Combustion of Coal

Q.—State the conditions in the furnace of a coal burning boiler upon which the burning of coal without smoke and with a minimum of soot deposit on boiler tubes are dependent.

A.—These conditions are:

(a) An adequate air supply.

(b) The securing of intimate contact between the air and coal together with the gases given off therefrom.

(c) The maintaining of this mixture of air and gases at a temperature of incandescence in order to secure the combustion of the gases before they become cooled below the temperature of ignition by contact with the heating surfaces of the boiler.

Vibration in Blowers

Q.—What are the usual causes of vibration in blowers?

A.—Vibration may be caused by one or more of the following:

Bearings too loose or improperly lubricated.
Worn ball thrust bearings.
Rubbing or binding of parts.
Fan out of balance.
Blower out of alinement.
Loose foundation bolts or rivets.

Setting Up on Bolts in Pipe Flanges

Q.—In the erection of steam pipe lines, is the practice of forcing a connection or alinement by means of setting up on the bolts through the flanges defensible?

A.—Every effort should be made to secure proper alinement and close contact between pipe flanges, so as to avoid setting up serious stresses in bolts and flanges. Failure to observe this precaution may result in rupture.

Standards

Q.—There is a great deal of interest in the subject of standards both in this country and abroad. What is a "standard" and what makes it such?

A.—The following is quoted by Dr. Immich in an article on "Practical Standardization in Shipyards:"

"Standards are specifications or regulations which have proven practical, satisfactory and standard on the basis of extensive experience and careful thought, in all of which, constructive, technical and economic questions are all of equal importance."

Indications of Lack of Alinement in Reciprocating Engines

Q.—State some facts which might indicate a lack of proper alinement in a reciprocating engine.

A.—A properly fitted, lubricated, clean bearing which continually runs warm.

Apparent vertical motion of crank shaft bearings.

Leaks in piston and valve rod stuffing boxes.

Wobbling of piston rod or valve stem.

Longitudinal displacement along the crank pin of the lower end of a connecting rod as the crank revolves.

Welding vs. Riveting

Q.—Welding has been adopted to an ever increasing degree in shipyard practice during the past few years. Several years ago a ship was constructed complete without riveting, welding being used for connecting all members. Why has not riveting been entirely displaced by welding?

A.—Welding is the subject of continuous study and experiment. The methods used are undergoing constant improvement. However, the quality of the connections secured by welding are as yet so largely dependent upon the skill of the operator that it is not considered good practice to weld members upon which the safety of the ship depends.

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

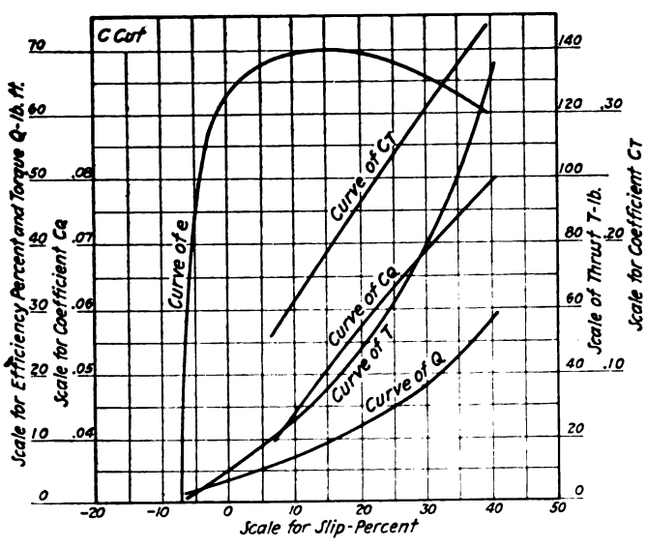
This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Schaffran's Propeller Data

Q. (1,366).—I wish to make use of the Schaffran method for analytical purposes of boat tests, basing myself on the data supplied by J. C. Robertson, which was inserted in the March, 1923, copy of MARINE ENGINEERING AND SHIPPING AGE. Are any books published pertaining to the C_T C_Q and e curves and to propellers, in Taylor's "Standard Series"; I am acquainted only with those relating to propellers Nos. 569, 570 and 571, as published in the December, 1922 issue of MARINE ENGINEERING AND SHIPPING AGE, on page 786. Would there be any benefit in using the "analytical pitch," equivalent to 1.1 times the pitch of the active face, and the true interpretation of the inscriptions "Analysis Slip Ratio," "C_T Efficiency," and "Formula C_T," mentioned on cut given on page 172, in your March, 1922, issue.

A. (1,366).—Schaffran's material to which you refer was published in the German paper *Schiffbau*, during June and July, 1915.

The writer is not acquainted with any books devoted to Schaffran's method of presenting propeller data. However, in addition to his discussion in the March, 1923, issue of MARINE ENGINEERING AND SHIPPING AGE, Mr. Robertson in the April issue of the same magazine, same year, discusses "Factors which a propeller formula should contain." In the body of this discussion he quotes Froude's propeller formula for thrust horsepower. This formula involves both



See Fig. 196, "Speed and Power of Ships," D. W. Taylor

the analysis pitch and the analysis slip ratio. These factors are probably essential to the expression of the results of propeller tests by formula. Mr. Robertson appears to have covered the question in his March article, where he writes as follows: "This has made it possible to express the results of the Froude propeller tests in a mathematical formula, whereas Taylor's tests are simply presented as curves of performance plotted on face slip.

"Each method has its own value. Taylor's method is probably more accurate for propellers similar to those tested, whereas Froude's propellers, being correlated by formula, are probably better for interpolation or extrapolation."

In G. S. Baker's "Ship Form Resistance and Screw Propulsion" the effective or analysis pitch is defined as "that calculated from the revolutions of no thrust. Thus, if at speed V in feet per minute the propeller develops no thrust when the revolutions are r per minute, the effective pitch is given by $\frac{v}{r}$. When the thrust of the propeller is zero, the slip calculated from this pitch is also zero."

Reference should also be made to the section of Mr. Baker's book, referred to above, which deals with the use of "Model Screw Data for Estimating Purposes."

The coefficients C_T and C_Q are, respectively, the thrust and torque characteristics for a given propeller of which e is the efficiency. These coefficients are further defined by the following formulæ:

$$C_T = \frac{T}{N^2 P^2 D^2}.$$

$$C_Q = \frac{Q}{N^2 P^2 D^5}.$$

$$e = \frac{TV}{2\pi Q N}.$$

Where Q = Torque (foot-pounds)
T = Thrust (pounds)
N = Revolutions per second
V = Speed of advance (feet per second)
P = Pitch of propeller (feet)
D = Diameter (feet)

While the writer is not familiar with other propeller data than those mentioned, presented in the Schaffran form, it would appear possible to derive such data from those given on plates Nos. 185 to 208, inclusive, of Taylor's "Speed and Power of Ships." These plates show the results of Taylor's systematic experiments on three-bladed propellers and give curves of efficiency, thrust and torque for each of five propellers at pitch ratios of 0.6, 0.8, 1.0, 1.5 and 2.0. By the use of the formulæ above noted the data can be found and curves of C_T and C_Q plotted therefrom.

For example, take Fig. 196, Taylor's "Speed and Power of Ships," using "C cut" propeller No. 13. The slip is nominal, speed of advance 5 knots (8.46 feet per second). The diameter and pitch are each 1.334 feet, the pitch ratio being 1.0.

$$\text{Then slip} = s = \frac{N P - 8.46}{N P}$$

$$\text{whence } N = \frac{6.34}{1 - s}$$

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Slip per-cent	1-s	Torque in ft. lbs. Q	Thrust in lbs. T	Rev. per sec. N	N³	P⁵D⁵	C_T	C_Q
*10	.90	*6.7	*25.0	7.05	49.6	3.16	.159	.043
20	.80	11.2	46.0	7.92	62.7	3.16	.233	.057
30	.70	18.0	78.0	9.15	83.6	3.16	.296	.068
40	.60	28.0	131.0	10.56	111.5	3.16	.371	.079

* These data are read from Fig. 196.

The above data are shown in the figure on page 110.

Aluminum

Q. (1,370).—Aluminum and aluminum alloys are increasingly important in ship construction and elsewhere. Can you furnish any information as to methods and precautions to be observed in connection with its use?

A. (1,370).—Aluminum is of limited strength and, as commercially available, is subject to salt water corrosion though not now to the same extent as was formerly the case. At the present time it is not considered suitable for use where watertightness or the structural integrity of the ship is involved.

In general it should not be used in intimate contact with non-magnetic materials such as copper, brass or bronze because of the severe electrolytic action resulting. When close proximity of aluminum fittings to non-magnetic materials is unavoidable the adjacent surfaces should be coated with marine glue or bituminous solution. Where practicable bushings or spacers of corrosion resisting steel are desirable. All crevices should be avoided as they collect moisture and invite corrosion.

Aluminum fitted in contact with steel does not produce severe electrolytic action. However, less trouble is to be anticipated from contact between aluminum and galvanized steel than when the steel is bare. When aluminum is secured to steel the faying surfaces should be coated with marine glue or bituminous solution.

When aluminum is to be fitted to wood marine glue or bituminous solution is to be applied to faying surfaces prior to assembly. Without this precaution exposure to salt water will result in the rapid corrosion of the aluminum.

In general, aluminum fittings should be secured by bolts, screws, or rivets of steel. These should be painted prior to assembly.

NEW BOOKS

THE STORY OF THE ROTOR. By Anton Flettner. Size, 6 by 9 inches. Pages, 110. Illustrations, 30. New York, 1926: F. O. Willhofft, 68 Beaver Street.

In publishing a transcript of Herr Flettner's own story of the rotorship and the various inventions and developments which led up to it, Mr. Willhofft has not only succeeded in producing a very readable and attractive little book, but has rendered a distinct service to the shipping public.

While much has been published with reference to the subject, particularly in German, there has been little which gave to the average reader, even though he possessed a fair grounding in technical matters, more than a fleeting glance of the actual working of the rotors and the principles underlying their operation—there has been too much of the higher mathematics and the theories of physics brought into the descriptions to allow the layman to get any very definite idea as to what it was all about.

The new book leads the reader through the preliminary stages of Herr Flettner's work, of his studies of airplanes and rudders and brings him to the final stage, the rotorship, with some comprehension of the nature of fluid currents and their action, and the ability to grasp without great difficulty the idea of the rotor and its method of operation.

PETROLEUM PRODUCTS AND ITS TRANSPORT AND PETROLEUM TABLES. By Capt. P. Jansen. Size, 6 by 9 inches. Pages, 107. Illustrations, 6. South Shields, 1925: T. L. Ainsley, Mill Dam.

This book, which has been prepared primarily for the use of officers of oil tank vessels, is the work of an official of the Anglo-Saxon Petroleum Company. It contains considerable general information relative to various petroleum products and to tank vessels and instructions, in great detail, concerning the handling of the latter, the loading and discharging of cargo and the precautions to be taken in dealing with various types of oils, benzine, gasoline and naptha.

A large number of useful tables are included which have a particular bearing upon the subject.

STABILITY AND SEAWORTHINESS OF SHIPS. By T. B. Abell. Size, 5¼ by 8¼ inches. Pages, 297. Illustrations, 154. London, England, 1926: The University Press of Liverpool Ltd., and Hodder and Stoughton, Ltd., London.

Certainly one of the best if not the very best work on the stability of ships from the view point of the practical operator or sea captain has recently come from the pen of Professor T. B. Abell who occupies the chair of naval architecture at the University of Liverpool.

In this country, particularly, the new book will attract attention because of the recent tentative report of the Committee on Stability and Loading, a report which while it deals primarily with the designer's side of the question has aroused the interest of shipowners and drawn forth much criticism, both favorable and opposed, to the proposed attempt to regulate stability and loading by rule or statute.

Whatever may be the future course of the matter as concerns possible governmental regulation, there can be no question as to the very great importance of an intelligent understanding, on the part of the shipmaster, of the characteristics of the vessel in his charge as affecting her stability and seaworthiness. This knowledge Professor Abell's book aims to impart and, on the whole, it does not appear possible to greatly improve the manner in which this aim is realized.

At the best, the principles underlying the actions of floating bodies are involved and complicated and as one proceeds from the ship at rest to the ship in motion the complication increases at a rather startling rate. For the non-technical mind to arrive at a definite basis of understanding, certain quite new ideas must be developed and the inception and digestion of a new idea takes time—it is not a matter for one sitting. The new book demands careful reading and concentration, but the time devoted to it will be most amply repaid—to the naval architect as well as the shipmaster.

While the text, as a whole, is quite clear there are certain sections which appear a little befogged as, for instance, in the treating of free surfaces where two methods of calculating their effect are given, equally correct and to the trained naval architect equally clear, but the relation between the two might not be so obvious to the layman and cause considerable confusion of mind. Again in the matter of adding a small weight, the directions, if followed, will ensure the desired result, but the basis of these directions leaves some room for speculation as to what it is all about. However, the mathematics of the surface of flotation are not of a nature that the average practical man will take to kindly; probably the explanations are as clear as they possibly can be made without the use of mathematics and Professor Abell has wisely omitted the equations and formulæ. A similar omission might, with advantage, be made in certain other sections of the book.

On the other hand, certain sections of the work stand

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out as monuments of clear and lucid explanations of difficult and involved subjects. The description of the movements of a vessel in a seaway and the explanation of the various forces affecting the action of a ship in motion are by far the simplest, clearest and in consequence the best we have ever met with.

The chapters on small and negative stability and upon seaworthiness demand particular attention and what the author has to say regarding correction of heel in a tender vessel and other similar problems arising in the handling of water ballast is of outstanding importance but so clearly stated and well illustrated as to have little room for misunderstanding.

The book is divided into eleven chapters, as follows:

I. Weight and Center of Gravity.
II. Buoyancy and Center of Buoyancy.
III. Equilibrium and Stability.
IV. Experimental Determination of Stability.
V. The Ship in Motion.
VI. Special Cargoes.
VII. Loading and Ballasting.
VIII. Trim.
IX. Small Stability and Negative Stability.
X. Seaworthiness.
XI. Estimates of Areas and Volumes and of Centers of Gravity or Centers of Figure of Areas and Volumes.

The book is extremely well printed and illustrated. It should find a place on the bookshelf of every naval architect worthy of the name and of every sea captain who really desires to know his ship and to understand the forces which control her behavior at sea.

LETTERS TO THE EDITORS

The United States Lines

NEW YORK, N. Y.

TO THE EDITORS:

The editorial, appearing on page 4 of the January issue, under the heading, "The United States Lines," dealing with the proposals which have been made to the Shipping Board for the purchase of the American Merchant Lines and the charter of the United States Lines, is singularly appropriate, terse and timely, besides indicating a keen appreciation of what is best for the future of this transatlantic passenger, mail and cargo service. New construction is the keystone of the "arch of continuity" of this service. The President's messages to Congress do not incline one to the view that any ship construction program involving the use of government funds will be undertaken; for this reason, the future of the American flag on the North Atlantic passenger lanes depends upon the ultimate decision of the Shipping Board with respect to these proposals. At this writing no decision has been announced.*

The fleet of the United States Lines, inadequate and unbalanced as it is, together with the start that has been made during the past six years, represents an opportunity, which if taken advantage of, will ensure to us a place on the North Atlantic. If this opportunity is allowed to lapse, the vessels now in service continued in operation until depreciation and obsolescence shall have taken their toll without new vessels to replace them and unless an entirely different policy toward shipping is adopted by the nation, it is not too much to say that in our time this important trade route will be wholly in the control of our foreign competitors. That is to say, it is not believed that any private American interests, in the absence of some suitable vessels, pier leases, agency and other business connections, will undertake to establish from "dead-cold," a representative and competitive fleet in the North Atlantic.

In the testimony and data before the sub-committee of the committee on commerce of the United States Senate inquiring into the proposals for sale or charter of this fleet, the importance of the North Atlantic passenger service, considered from the viewpoints of national defense and political or commercial welfare of the United States, has been discussed. Suffice it to say here that the United States will suffer in prestige, and will not rank as a first class nation in its intercourse with other nations, unless great efforts are made for it to gain and retain without interruption its rightful place on the North Atlantic. This is due to our close connection in race and sympathy with the nations of Europe. This trade is highly competitive, and, it is believed, it will always be so; in it are to be found the very latest examples of naval architecture, marine engineering and shipbuilding.

Since the war, changes of a basic nature have taken place in this trade; the United States Immigration Act has had a very decided influence on the traffic and the types of vessels best suited for the service. With the development to date and considering the trend, it is safe to say that the passenger traffic in the near future will be accommodated in two distinct types of vessels; the large high speed vessel will be used for the "first class," "tourist class," and "third class" passengers—the intermediate moderate speed vessel will be used for "cabin class" and "third class" passengers. The "second class" business, once an important part of the total, is giving way to the "tourist" of the large high speed vessel and to the "cabin" of the intermediate moderate speed vessel.

Both of these two types of vessels are necessary, each an important adjunct to the other, sufficient vessels of both types forming a well balanced fleet suitable for competitive service.

In support of this, reference will be made to the passenger carryings of vessels in the Atlantic Conference. In 1925, a total of 72,123 first class passengers were carried eastbound, and a total of 80,944 first class passengers were carried westbound, making a total carried in both directions of 153,067 first class passengers. In this same period a total of 75,156 cabin class passengers were carried eastbound and a total of 103,881 cabin class passengers were carried westbound, making a total of 179,037 cabin class passengers. This represents about 11.7 percent more cabin passengers than first class.

In the first eleven months of 1926, similar figures are available, but for brevity the increase of cabin class passengers over first class passengers was about 5 percent.

The cabin class business is an important part of the total, equally so with the first class, and ships should be provided to take care of this business, as well as ships for the first class trade.

After considering the present active vessels comprising the fleet of the United States Lines, the vessels in lay-up available for service after reconditioning, the present vessels of the American Merchant Lines, and having in mind the very considerable outlay necessary for new construction, it is my opinion that the right kind of a fleet for the United States Lines enabling it to offer a regular and balanced service in the North Atlantic would be comprised of the following:

Two 25-knot steamers to run with the *Leviathan*, making a weekly service sailing from New York on Saturdays, and from Southampton on Tuesdays.

Five 16- to 18-knot steamers of the cabin class type to operate on a weekly basis between New York, Ireland, England, France

* All proposals for the sale and charter of the American Merchant and the United States Lines were rejected by the Shipping Board at its regular weekly meeting on January 24.—THE EDITORS.

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and Germany. With the *George Washington* (converted for cabin service), the *President Harding*, the *President Roosevelt*, the *America* (restored as a cabin vessel), and the *Mount Vernon* (reconditioned for cabin service, 18 knots as proposed last Spring), it would be possible to have a mid-week sailing from New York. This would avoid the uneconomic "pushing" that has taken place with the *George Washington* and the *America* in the past. The *Republic* could be operated as an extra steamer not on the weekly service, and would also be available as a spare ship to enable holding the schedule in the event of the withdrawal of one of the five cabin ships, for any reason.

The five steamers of the American Merchant Lines, the *American Merchant*, the *American Trader*, the *American Shipper*, the *American Banker* and the *American Farmer*, to maintain a weekly service sailing from New York on Thursday operating in the London service.

If by reason of the comparatively large expenditure necessary, or for other reasons, the construction of two running mates for the *Leviathan* cannot be undertaken at once, but it is possible to construct and place on service at the earliest possible date one large high speed vessel as one of the bidders proposes to build without the aid afforded by the Construction Loan Fund, then the next best service could be given along the lines indicated by the following schedule:

With the *Leviathan* and the new ship, each providing a Saturday sailing from New York and a Tuesday sailing from Southampton, there remains one sailing every third week to be taken care of by other vessels. In order to give this weekly service sailing, it is proposed that the *George Washington* (retained as a first class vessel until the third vessel of the *Leviathan* group is available), the *America* (restored as a cabin vessel), and the *Mount Vernon* (reconditioned for cabin service, 18 knots speed) be placed on a 4½ week schedule. This would enable these vessels to fill in the gap in the weekly Saturday sailing, and, in addition, they would contribute a mid-week or Wednesday sailing on alternative trips. These mid-week sailings would be augmented with sailings of the *President Harding* and *President Roosevelt* and the *Republic* operating on a 4 and 5 week schedule alternatively, so that the fleet would provide a Saturday and also a Wednesday sailing each week.

The five steamers of the American Merchant Lines, operating in the London service, would maintain a weekly sailing on Thursdays from New York.

The point I wish to stress is that an adequate fleet for the North Atlantic service is not one composed solely of large high speed first class vessels, but is one having, in addition to the so-called capital ships, vessels of the *George Washington* and *America* type, and these in sufficient quantity to form a balanced service. It is for this reason that I feel it is imperative that the *America* and the *Mount Vernon* be restored to service as cabin class ships. As such they would form an essential part of the United States Lines' fleet.

I do not incline to the view that the *America* and the *Mount Vernon* cannot be made serviceable as units of the Merchant Marine except with the expenditure of $5,000,000 and $8,000,000 respectively, and that these vessels should be laid up in the James River because of their potential value in event of war. On the contrary. I believe these vessels are valuable to the merchant marine, to the United States Lines in particular, and should be reconditioned and placed in service at the earliest possible moment, without further delay that has characterized the dealings of the Shipping Board with respect to them. The *America* can be placed in first class condition, retaining coal as fuel, for an expenditure of $2,500,000, while the *Mount Vernon* can be reconditioned for the cabin service, 18 knots speed, retaining coal as fuel, for an expenditure of $3,500,000. These figures being based upon firm bids obtained last Spring.

Considering the age of these vessels (the *Mount Vernon* being 20 years and the *America* almost 21 years), also that if reconditioned according to *any* specifications the probable future useful life as competitive units would not exceed another ten years. I say that it would be very imprudent to expend anything like $8,000,000 and $5,000,000 respectively for their reconditioning. There is a very considerable investment in these two vessels as they stand today; both of them are sorely needed in the United States Lines, and in the absence of a very large construction program, much more extensive and sweeping than has yet been proposed, it is an unwise and shortsighted policy which would neglect placing them in service along the lines indicated.

Finally, provide, by new construction, running mates for the *Leviathan* and recondition existing vessels in lay-up to round out the cabin service. If this is not done while under direct government operation, then by all means let us have private ownership and/or private operation where this is probable according to the proposals which have been made. A good start has been made in establishing an American passenger and mail service in the North Atlantic, do not let us quit at the critical moment.

CARL E. PETERSEN.

PERSONAL MENTION

A. J. PANCOTT, formerly chief engineer of the steamship *Waukegan*, is now chief engineer of the Shipping Board motorship *West Cusseta*.

C. T. KLEIN, formerly serving on vessels of the Ore Steamship Company, is first assistant engineer on the Shipping Board motorship *West Honaker*.

CHARLES COBURN, formerly second assistant engineer of the motorship *Tampa*, has been promoted to first assistant engineer of this vessel. Mr. Coburn was formerly first assistant engineer on the motorship *Miller County*.

K. L. HANSEN, who was chief engineer of the S. S. *Jalapa* for over 3 years, has been appointed chief engineer of the Shipping Board motorship *Unicoi*.

THOMAS H. ALLEN has been appointed assistant works manager of the American Brown Boveri Electric Corporation, Camden, N. J. Mr. Allen will have charge of all shipbuilding activities.

O. A. HORN, formerly chief engineer of the motorship *Seekonk* of the United American Lines, has been appointed first assistant engineer of the Shipping Board motorship *Unicoi*.

JOHN BROWN, for the past two years chief engineer of the steamship *Horace Luckenbach* of the Luckenbach Steamship Company, has been made chief engineer of the Shipping Board motorship *West Honaker*.

S. W. WAKEMAN, vice president and general manager of the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., was recently elected a member of the administrative council of the Atlantic Coast Shipbuilders Association.

O. E. ABBOTT has been elected president of the Cleveland branch of the Marine Engineers' Beneficial Association and William Kelly was made a delegate to the annual national meeting called in Washington, D. C., on February 14.

D. F. MENTZER has been appointed first assistant engineer of the motorship *West Cusseta*. Mr. Mentzer has served as licensed engineer on a number of motor vessels during recent years and was first assistant engineer of the motorship *Jacksonville* when he took up Diesel engine work with the Shipping Board.

W. C. DOWE was recently promoted from first assistant to chief engineer of the Shipping Board motorship *Tampa*, succeeding L. H. Hirschy who has been transferred to the

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Diesel section of the Maintenance and Repair Division of the Shipping Board Emergency Fleet Corporation. Before entering the Shipping Board service Mr. Dowe was chief engineer of the steamship *Archer*.

F. D. HESLEY, supervising local manager of the maintenance and repair division of the Emergency Fleet Corporation, New York, has resigned to become manager of the Todd Shipyards plant at New Orleans, La. Mr. Hesley has been in the service of the Fleet Corporation for the past seven and one-half years.

CAPTAIN DAVID O. CAMPBELL, well known in shipping circles and for about 10 years marine superintendent of the Garland Line, has joined the Merchant Line of Colombia, 80 Broad street, New York. The company recently inaugurated a regular monthly service between New York and Colombian Pacific ports.

B. C. EDWARDS, resident inspector of Diesel engine installations at the Newport News yard and formerly general inspector at New York for the maintenance and repair division of the Emergency Fleet Corporation, New York, has been made supervising local manager of this department, succeeding F. D. Hesley, resigned.

ELISHA WALKER, president and chairman of the board of Blair and Company, Inc., New York, has been elected a director of the American Brown Boveri Electric Corporation, Camden, N. J., to fill a vacancy and Henry Lockhart, Jr., vice president of Blair and Company, Inc., has been elected to succeed Felix Jenkins, resigned.

WALTER B. POLLOCK, manager of the marine department of the New York Central Railroad, 466 Lexington avenue, New York, for the past 20 years, has retired under the pension rules of the company and is succeeded by F. N. Melius, who will also continue to perform the duties of general superintendent of the New York terminal district.

VICTOR J. FREEZE has been appointed traffic manager of the New York district for the Fleet Corporation, following the consolidation of four traffic departments brought about by the resignation of James Sinclair on December 31. The departments, which formerly were operated by four executives and now are under Mr. Freeze's control, are the United Kingdom, South America and Far East Conferences and the chartering department.

WINCHESTER NOYES was re-elected president of the United States Ship Operators' Association, New York, at the annual election. Other officers were elected as follows: J. T. Lykes, first vice president; C. D. Mallory, second vice president; A. W. Parry, Jr., Tampa Inter-ocean Steamship Company, secretary, and Lon Hudson, Cosmopolitan Shipping Company, treasurer. The following were elected members of the board of governors for three-year terms: A. L. Burbank of A. H. Bull & Company; A. W. Parry, Jr.; J. T. Lykes and A. V. Moore, president of the Moore & McCormack Company.

W. J. MERTEN, of the Westinghouse Electric and Manufacturing Company, has just been appointed chairman of the recommended practice committee of the American Society of Steel Treaters. This committee is a national one and is empowered to act on technical work done by subcommittees, is responsible for the publication of data sheets and also for the publication of the material contained in the handbook of the society. Mr. Merten has been a member of the recommended practice committee since its inception and has also acted as chairman of the sub-committee on tool steels, and chairman of the Pittsburgh Chapter of A.S.S.T. Mr. Merten is a member of the American Institute of Mining and Metallurgical Engineers, the American Society for Steel Treating, the American Chemical Society and the Engineers Society of Western Pennsylvania.

THOMAS H. ROSSBOTTOM, formerly general manager of the United States Lines, was elected first vice president of the Panama Railroad Company, New York, at a special meeting of the board of directors. In his new position Mr. Rossbottom will be in charge of the operation of the six passenger, cargo and mail steamers in service between New York and the Canal Zone. Mr. Rossbottom entered the service of the company on August 1, 1887, and has been in its employ ever since, with the exception of the five years' leave of absence during which he acted as general manager of the United States Lines. He succeeds Edward A. Drake, former active head of the company, who died recently.

T. H. Rossbottom

H. H. RAYMOND, president of the Clyde and Mallory Steamship Lines, was elected chairman of the board of directors of the Atlantic, Gulf and West Indies Steamship Lines and its subsidiaries at a meeting of the board of directors on January 10. Mr. Raymond was elected to fill the vacancy caused by the death of Galen L. Stone, Boston financier and a member of Hayden, Stone and Company. Mr. Raymond was born at Yarmouth, Nova Scotia. After finishing his studies at the Yarmouth Academy he became a clerk in what was known as the Yarmouth Line operating between Yarmouth, St. Johns and Boston. Arriving in the United States in the year 1884, Mr. Raymond found employment with the St. Johns River Transit Company. Two years later he joined the Mallory Line as purser of the steamer *State of Texas* which then operated between New York, Port Royal, S. C., and Fernandina, Fla. After two years as purser between New York and Southern ports he was made traveling agent of the Mallory Line.

H. H. Raymond

In 1889 he was located in the New York office but returned South in 1892 as general southern agent which post he held until 1899 when he was again called North and appointed superintendent in charge of operations and shortly after was made general manager. In 1907 he was elected vice president and general manager of both the Clyde and Mallory Lines following a reorganization. He was elected president of both companies in 1913 and continued as such until his recent election as chairman of the board. When the United States entered the European war in April, 1917, and the Council of National Defense was organized, Mr. Raymond was appointed a member. In

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January, 1918, he was made vice chairman of the Shipping Control Committee which directed the operations of merchant ships of the Allied Powers. In recognition of his services the French government conferred upon him the decoration *Chevalier of the Legion of Honor.*

FRANKLIN D. MOONEY, president of the Atlantic, Gulf and West Indies Steamship Lines, has been elected president of the Clyde and Mallory units to succeed H. H. Raymond, chairman of the board. Mr. Mooney has been prominent in shipping for the last 30 years. In 1903 at the age of 29 he became general manager of the New York and Porto Rico Line now part of the Agwi group. Because of his splendid record in the succeeding 18 years, he was chosen by the board of directors to head the Agwi Lines in 1921 when the shipping industry was reorganized after the war. Mr. Mooney is also president of the New York and Porto Rico Line and of the New York and Cuba Mail Steamship Company (Ward Line).

Franklin D. Mooney

JOHN J. EGAN, secretary of the Ocean Traffic Bureau of the Port of Philadelphia, tendered his resignation recently due to pressure of personal business. Erwin F. Flynn, associated with the bureau since its inception, was appointed to the vacancy.

T. LACEY GOODRICH, well known in Pacific coast shipping circles, and for many years identified with the T. K. K. Steamship Company, has been named agent for the Dollar Company at Iloilo, P. I. James Wills, equally well known in Pacific shipping circles, has been appointed Dollar agent at Cebu.

GEORGE W. CODRINGTON, vice president and general manager of The Winton Engine Company, Cleveland, O., returned on the *Berengaria* recently from a six weeks' business and pleasure trip to Europe. Mr. Codrington reports that he had an interesting trip and that he enjoyed especially the time spent at the plants of some of the European Diesel engine builders. "The leaders in the Diesel engine industry abroad are a progressive, high grade group of men," says Mr. Codrington. "Coming into close contact with them, getting their viewpoint on various features of Diesel engine designing and building of interest and special significance to me, was a rare privilege, and to partake of their unexpected and cordial hospitality a never-to-be-forgotten pleasure." Mr. Codrington visited the following plants: Germania Werft, Kiel, Germany; M. A. N. Diesel Plant at Augsburg, Germany; Sulzer Brothers, Ltd., Winterthur, Switzerland, and the Krupp Steel Plant, Essen, Germany. His itinerary included Hamburg, Berlin, London, Glasgow and Paris.

G. W. Codrington

DR. STEPHEN E. SLOCUM, consulting engineer, Ardmore, Pa., has been awarded the gold medal of the American Society of Naval Engineers as well as life membership in the society for an original monograph entitled "Practical Application of Modern Hydro-dynamics to Marine Propulsion," which will appear as the leading article in the February number of the *Journal* of the society. This article presents the fundamental principles of his research in the field of the modern circulation theory of flow as applied particularly to marine propulsion. It will be recalled that several articles on the special features of circulation propellers, as well as on the propulsive efficiency obtained on various ships on which wheels of this type are installed, have appeared in MARINE ENGINEERING AND SHIPPING AGE at various times. The propeller problem is generally recognized as a difficult subject, and to successfully apply an abstract principle like that of circulation flow to marine propellers on a commercial scale requires patient and persevering effort, and its value to the field of marine engineering is recognized in this award. Circulation propellers designed by Dr. Slocum are now in successful operation on a wide variety of vessels, including tugs, barges, yachts and steam, Diesel and Diesel-electric tankers and merchant ships. Installations within the last few weeks include the twin-screw tanker *E. T. Bedford* of the Standard Oil Company of N. J., which had its trial trip on December 1, 1926; the merchant ship *Unicoi* of the United States Shipping Board, which had its trial trip at Newport News on December 22, 1926; a twin-screw barge for the Tidewater Oil Company, now under construction; and three Diesel-electric ships for the Atlantic Refining Company, now under conversion. Dr. Slocum took his engineering degree at Union College, and, following his graduation, specialized for three years in mathematics and physics at Clark University, where he took his doctor's degree. For a number of years he was professor of applied mechanics at the University of Cincinnati, and resigned his position to come East and take up his present line of work.

Dr. S. E. Slocum

OBITUARY

CAPTAIN JOHN A. SPILMAN, president of the Maryland Dry Dock Company, Baltimore, Md., died on Sunday, January 9. He was in charge of government fleet construction work during the war and formerly was naval constructor at the Boston Navy Yard. Captain Spilman was 49 years of age.

GALEN L. STONE, chairman of the board of directors of the Atlantic, Gulf and West Indies Steamship Lines and head of the Eastern Steamship Lines, died on Monday, December 27, at his home in Brookline, Mass. Mr. Stone was 64 years of age.

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The Month's Shipping and Shipbuilding News in Brief

Shipyard, Steamship and Port Activities and Other Notes of Interest in All Branches of the Marine Industries

Specifications Issued by Shipping Board for Conversion of Three Ships to Diesel Drive

SPECIFICATIONS were issued on Wednesday, January 26, by the Maintenance and Repair Division of the United States Shipping Board Emergency Fleet Corporation for the conversion of the steamships *Yomachichi, Seminole* and *West Grama* from steam engine drive to oil engine drive, including rearrangement of crews quarters and spaces, provision of passenger accommodations, repairs, renewals, painting and refinishing, drydocking, etc. These three vessels comprise the 9th, 10th and 11th vessels in the Shipping Board's Diesel conversion program. Bids will be opened Tuesday, February 15.

The general characteristics of these vessels after conversion to motor vessels are as follows:

YOMACHICHI

Length overall ..... 416 feet
Beam, molded ..... 54 feet
Depth, molded ..... 33 feet 9 inches
Gross tonnage 5,950
Net tonnage 3,665
Normal mean load draft ..... 26 feet 10¾ inches
Deadweight carrying capacity on above draft (about) ..... 9,400 tons
Builder of main engine..Busch-Sulzer Brothers, Diesel Engine Company, St. Louis, Mo.
Type of engine..six-cylinder, two-cycle, single-acting brake horsepower 3,000
Normal speed in service condition..About 11.6 knots.
Passenger accommodations ..... For 15 persons

WEST GRAMA

Length overall ..... 425 feet 1 inch
Beam, molded ..... 54 feet
Depth, molded ..... 29 feet 9 inches
Gross tonnage 5,424
Net tonnage 3,372
Normal mean load draft ..... 23 feet 11¼ inch
Deadweight carrying capacity on above draft (about) ..... 8,000 tons
Builder of main engine..McIntosh and Seymour Corporation, Auburn, New York.
Type of engine..Four-cylinder, four-cycle, double-acting.

SEMINOLE

The characteristics of the *Seminole* are the same as the *Yomachichi* except that the engine will be the product of the Hooven, Owen, Rentschler Company, Hamilton, Ohio, and will be of 4-cylinder, 2-cycle double-acting type, with a brake horsepower of 3,300 and a normal speed in service condition of 11.9 knots. She will have accommodations for 15 passengers.

Shipping Board Rejects Bids for United States Lines

THE Shipping Board announced on January 24 its decision to reject all bids received for the purchase or charter of the United States Lines, including the *Leviathan,* and the American Merchant Lines. Chairman O'Connor had testified before the Senate commerce committee that the board would have rejected the bids even without the action of the Senate in requesting that action be postponed pending a hearing before the committee.

Pusey and Jones Co. to Build Large Diesel Yacht Costing $1,250,000

A CONTRACT for the construction of one of the largest yachts ever built in America has been placed with the Pusey and Jones Company at Wilmington, Del., for Colonel Edward Green, son of the late Hettie Green of New York. The yacht will have an overall length of 294 feet, beam 38 feet and depth 25 feet. It will be powered with two Bessemer Diesel engines, each of 1,500 horsepower, and will have quarters for a crew of 60 and a large number of passengers. The vessel will be completed in about a year's time at an estimated cost of $1,250,000. Henry J. Gielow, Inc., naval architects of New York City, were the designers.

In addition to the two main engines, the Bessemer Company will also build two 170-horsepower Diesels that will be directly connected with 100-kilowatt generators, to be used for lighting the yacht.

Pacific Coast Engineering Co. to Build Seattle Fireboat

A CONTRACT for the construction of a fireboat for the city of Seattle, Washington, has been awarded to the Pacific Coast Engineering Company, Oakland, California, at a price of $199,613, bids for which were received and opened by C. B. Bagley, secretary of the Board of Public Works at Seattle, on January 14, 1927.

The fireboat is to have a length overall of 123 feet 6 inches; length between perpendiculars, 118 feet; beam, 26 feet; draft, 7 feet 6 inches. She is to be powered with gasoline engines driving through triple screws, and the estimated speed of the boat is 14 knots. Six 4-stage centrifugal pumps are to be installed having a total pumping capacity of 12,000 gallons per minute at a working pressure of 200 pounds per square inch.

New Bids to Be Asked for Governor's Island Ferryboat

ACCORDING to official information received from the United States Army Engineers, Washington, D. C., all bids recently received for the construction of a new ferryboat for service between Governor's Island and the Battery, New York, have been rejected. Plans are now under way for the receipt of new bids.

Chester Yard to Repair U. S. Army Dredge New Orleans

THE Sun Shipbuilding and Drydock Company, Chester, Pa., has been awarded a contract by the War Department for repairing the dredge *New Orleans.* The price involved was not made public.

Sun Shipyard to Begin Construction of Tanker for Sun Oil Co.

A CONTRACT for the construction of a 15,000-ton tanker, which will replace the motorship *Miller County* recently sold to the Standard Transportation Company, and the tanker *Sun,* disposed of to the Mutual Lloyd Marine Company, has been awarded to the Sun Shipbuilding and Drydock Company, Chester, Pa., by the Sun Oil Company, Philadelphia, Pa. The keel for this vessel will be laid within a short time.

The new tanker probably will be propelled by Sun-Doxford oil engines, which will give the ship a speed of between 14 and 15 knots. It will be more than 500 feet long and will have a beam of 65 feet. The vessel will be regularly employed, carrying bulk petroleum between Gulf, Mexican and California ports and the Sun Oil Company's refinery at Marcus Hook.

The announcement that the tanker would be built at Chester confirms the report which appeared in the January issue of MARINE ENGINEERING AND SHIPPING AGE, that one or more vessels of that type soon would be undertaken for the yard's own account.

Asiatic Petroleum Co. May Build 10,000 Ton Tanker

INFORMATION has been received that the firm of Lee Higginson and Company, New York, has commissioned T. G. Walker, naval architect for the Asiatic Petroleum Company, Ltd., to draw plans and specifications for the construction of a 10,000-ton oil tanker. The vessel, it is understood, will be propelled by reciprocating engines. It is believed that this tanker will be for service in the Asiatic Petroleum Company's fleet.

It is further thought that this action is the result of underwriters' adjustments in the case of the tanker *Silvanus,* which was in collision with the steamship *Thomas H. Wheeler* and suffered severe explosion damage in April, 1926. No information can be obtained as to when the specifications will be issued and bids asked covering the work.

Sun Shipyard to Build Tank Barges for Gulf Refining Co.

A CONTRACT for the construction of two tank barges for the Gulf Refining Company, Pittsburgh, Pa., has been awarded to the Sun Shipbuilding and Drydock Company, Chester, Pa. The new vessels are each to be 136 feet long, 27 feet beam and have a loaded draft of 11 feet. The contract price was not made public.

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Shipping Board to Order Six Auxiliary Diesel Engines

THE United States Shipping Board recently passed a resolution authorizing Commissioner Benson to purchase six additional auxiliary internal combustion engines in connection with the board's Diesel conversion program. The amounts authorized to be paid for these engines are not to exceed $16,500 each.

Guggenheim Yacht Undergoes Repairs

THE yacht *Trilorah*, property of S. R. Guggenheim, internationally known financier, has been docked at the Merrill-Stevens Drydock and Repair Company, Jacksonville, Fla., for repairs. The yacht was formerly named the Winchester and was a patrol ship during the war. It has an estimated speed of 35 knots and is built on the lines of a destroyer.

Staten Island Shipyard to Build Standard Transportation Company Tugboats

AS THE result of the bids which were received January 5 by the Standard Transportation Company, 26 Broadway, New York, for the construction of two tugboats, a contract has been awarded to the Staten Island Shipbuilding & Dry Dock Company, Staten Island, New York. The tugs, which are to be driven by reciprocating engines, will have a length of about 105 feet. The boilers are fitted to burn oil. The prices at which the award was made have not been made public.

Ferryboat Contract Placed with Winslow Shipyard

THE Sound Ferry Lines, Seattle, Washington, has awarded a contract for a $125,000 ferryboat to the Winslow Marine Railway and Shipbuilding Company, which has a plant at Winslow, Bainbridge Island. The new ferryboat will be of the single-end type, 160 feet long, 52 feet beam and 13 feet 9 inches in depth. She will be propelled by two 375 horsepower Washington-Estep Diesel engines, which will give the vessel a speed of 14 miles an hour. The engines are being built by the Washington Iron Works in Seattle. They each will have six cylinders and a total of 750 horsepower.

The new vessel will have a large observation room, a dining salon that will accommodate 50 persons and many features providing comfort and convenience. She will maintain a schedule of one hour and 10 minutes between Edmonds and Port Ludlow.

S.S. Monsella Repairs

THE 6,024-gross ton steamship *Monsella*, which is now docked at Jacksonville, Fla., is to be repaired by a shipyard at that place, at an estimated cost of $20,000, according to an announcement made by the South Atlantic Steamship Lines, agents for the vessel. The *Monsella* has a bunker capacity of 490,000 gallons and a cruising radius of 12,000 miles, burning oil fuel. Her home port is in San Francisco.

SHIP CONSTRUCTION AND REPAIR BIDS

Two Firms Submit Bids for New Coast Guard Cutter Machinery

TWO proposals were received by the Treasury Department, United States Coast Guard, Washington, D. C., on Tuesday, January 25, 1927, for furnishing three turbo-electric ship propulsion sets and other electrical and miscellaneous equipment for the Coast Guard cutters *Nos. 45, 46* and *47*. The tenders received were as follows:

	Price per set
Westinghouse Electric and Manufacturing Company	$102,700
(Alternate bid)	106,700
General Electric Company	126,000

After the contracts for the machinery are awarded, bids for the construction of the hulls will be invited. The three new vessels will be of the same design, the tonnage of each being about 1,800 or 1,900 tons and the speed about 16½ knots.

United States Engineers Open Bids for Diesel Towboat

TENDERS were received and opened on January 29, 1927, by the United States Engineer Office, St. Louis, Missouri, covering the construction of one 110-foot steel hull Diesel towboat. The vessel is to have a length overall of 131 feet 5/8-inch; length, molded, 110 feet; breadth, molded, 23 feet; depth, 5 feet; camber, 4 inches; mean draft loaded, with full supply of fuel, water, supplies and equipment, 3 feet 6 inches; sheer, forward, 2 feet 6 inches; sheer, aft at sides, 1 foot 6 inches.

The boat is to be equipped with one 300-brake horsepower vertical, multi-cylinder, two or four stroke cycle, air injection Diesel type engine, arranged for electric drive. It is to be the product of an American firm, regularly engaged in the manufacture of Diesel engines. The tenders submitted were as follows:

	Price "A"	Price "B"
Charles Ward Engineering Works	$136,300	$126,800
Nashville Bridge Company	136,742	131,700
Howard Ship Yards and Dock Company	142,936	146,703
Dravo Contracting ..Co....	147,525	137,550

The award has not as yet been made.

Bids Received for Alterations on Steamship Leviathan

TENDERS were received and opened at the office of the marine superintendent of the United States Lines, Pier 4, Hoboken, N. J., on Tuesday, January 18, covering additional rearrangement and fitting out of both the passenger accommodations and crew's quarters aboard the steamship *Leviathan*.

GENERAL CONTRACT

W. & A. Fletcher Company	$32,945
Tietjen & Lang Drydock Company	35,270
Morse Drydock and Repair Company	36,796
Atlantic Basin Iron Works	39,580

This work was awarded to the W. and A. Fletcher Company, Hoboken, N. J.

Alterations in the tourist section were not contracted for at this time. The low bid for the work, however, was submitted by the Rex Cabinet and Linoleum Company, with a price of $15,300.

ELECTRICAL WORK

Hart Enterprise Electric Company	$1,857
Charles Cory & Sons, Inc.	2,090
Westinghouse Electric and Manufacturing Company	2,500
Atlantic Basin Iron Works	2,646

The work was awarded to the Hart Enterprise Electric Company, New York.

NEW TABLES IN SECOND AND THIRD CABIN DINING ROOMS

Rex Cabinet and Linoleum Company	$4,710
Tietjen and Lang Drydock Company	6,151
Morse Drydock and Repair Company	6,453
Atlantic Basin Iron Works	8,675

This work was awarded to the Rex Cabinet and Linoleum Company, Union City, N. J.

WOODWORK, NEW LINEN ROOMS, ETC.

Morse Drydock and Repair Company	$15,566
W. & A. Fletcher Company	15,589
Rex Cabinet and Linoleum Company	17,900
Tietjen & Lang Drydock Company	19,296
Atlantic Basin Iron Works	20,242

Awarded to the Morse Drydock and Repair Company, Brooklyn, New York.

A number of small contracts of miscellaneous work were also awarded at this time.

Contract for Fitting New Staterooms on S.S. Leviathan Awarded

BIDS were opened recently at the office of the marine superintendent of the United States Lines, Pier 4, Hoboken, N. J., covering two specifications for clearing the former Ritz galley on the liner *Leviathan* and for fitting up three first class staterooms, one suite and a children's playroom. A contract for the removal work was awarded to the Tietjen and Lang Drydock Company, Hoboken, N. J., at a price of $6,885. Other bids were:

ALTERNATIVE BIDS—PRICES

Nashville Bridge Company	$139,800	$134,758	.....	.....	.....
Charles Ward Engineering Works	139,000	130,400	$124,550	$127,150	.....
Dravo Contracting Company	.....	135,500	132,500	.....	.....
Howard Ship Yards and Dock Company	143,091	147,311	132,473	134,473	$137,473

Morse Drydock and Repair Company	$7,115
W. & A. Fletcher Company	7,400
Atlantic Basin Iron Works	7,650

For the second contract the following bids were received:

Rex Cabinet and Linoleum Company	$53,096
Tietjen & Lang Drydock Company	65,000
W. & A. Fletcher Company	69,200

The award in this case was made to the Rex Cabinet and Linoleum Company, Union City, N. J.

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Robins Yard Receives Contract for Annual Overhaul of S.S. President Roosevelt

BIDS for the annual overhaul of the steamship *President Roosevelt*, operated by the United States Lines, New York, were recently opened at the office of the marine superintendent, Pier 4, Hoboken, N. J. Specifications as issued included drydocking and a general specification.

Two bids were received for the drydocking and cleaning, painting and hull work as follows:

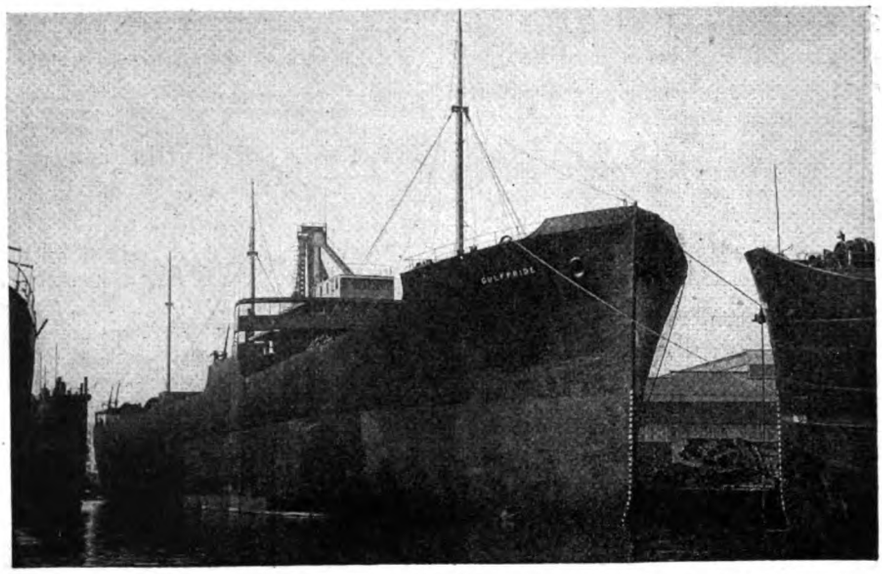
Robins Drydock and Repair Company..	$55,710
Morse Drydock and Repair Company....	59,760

The general specification also received two bids:

Robins Drydock and Repair Company..	$9,860
W. & A. Fletcher Company.....	16,585

Contracts for both specifications were placed with the Robins Drydock and Repair Company, Brooklyn, New York.

Specifications covering several small jobs on the *President Roosevelt* will be opened shortly.



Motor tanker Gulfpride just after launching at the Federal yard

S.S. Fredensbro Repair Bids Received

BIDS covering permanent repairs to the Danish steamship *Fredensbro* were received and opened at the office of Harold Herbick, Philadelphia, Pa., on Wednesday, January 19. The vessel is now in drydock at Philadelphia. The *Fredensbro* was submerged in the Delaware river off Camden, N. J., for more than a month. The Sun Shipbuilding and Drydock Company, Chester, Pa., effected the permanent repairs to her damaged side. The tenders submitted were as follows:

	Lump Sum	Time
Staten Island Shipbuilding Company	$90,274	65
Maryland Drydock Company	90,696	66
Bethlehem Shipbuilding Corporation, Ltd	91,492	60
W. and A. Fletcher Company	104,354	55
New York Harbor Drydock Company, Inc	104,871	60
Tietjen and Lang Drydock Company	106,842	65
Robins Drydock and Repair Company	108,220	65
Sun Shipbuilding and Drydock Company	116,000	96
Morse Drydock and Repair Company	121,674	70
Federal Shipbuilding Company	127,500	75
Newport News Shipbuilding and Drydock Company	139,300	75

Bids Received for Repairs to S. S. Dannedaike

TENDERS were received and opened at the office of Frank S. Martin and Son, naval architects of 25 Broadway, New York, on Tuesday, December 28, covering the reconditioning of the tanker *Dannedaike*, which was recently purchased from the United States Shipping Board by the American Tankers Corporation of Boston, Mass., with the following results:

Name	Lump Sum Price	Main Turbine Repair	C. R. D.
W. & A. Fletcher Company	$11,600	$2,840	15
New York Harbor Drydock Company	17,522	5,300	24
Morse Drydock and Repair Company	18,356	2,466	20
Staten Island Shipbuilding Company	18,757	4,870	21
Robins Drydock and Repair Company	19,750	6,170	18
Federal Shipbuilding Company	21,000	5,100	24
Capstaff and Hunter Turbine Works, Inc	21,940	3,005	21
Tietjen & Lang Drydock Company	22,590	5,985	20
Westinghouse Electric & Manufacturing Company	.....	4,187	14

Separate prices were submitted on a number of miscellaneous items which will bring the totals up several thousand dollars in each case. No award has as yet been made.

Launching of the Gulfpride

THE motor tankship *Gulfpride*, the largest seagoing motorship yet built in this country, was launched at the Federal Shipbuilding and Dry Dock Company's yard at Kearny, N. J., on January 20.

This vessel, which has attracted more than ordinary attention not only on account of her size but also because she is the first tank vessel to be built in America on Sir Joseph Isherwood's new "bracketless" system of construction, has the following general particulars:

Length overall	543 feet 11½ inches
Length between perpendiculars	525 feet 0 inches
Beam, molded	74 feet 0 inches
Depth, molded	40 feet 6 inches
Load draft	28 feet 0 inches
Deadweight	17,400 tons

The total cargo capacity is over 6,000,000 gallons.

The propelling machinery is to consist of two Bethlehem single-acting, two-cycle Diesel engines, driving twin screws, the total shaft horsepower being 4,000 and the service speed of the vessel 11 knots.

A most unusual and rather startling feature of the launch was the fact that, owing to the very heavy fog which prevailed at the time, the ship entirely disappeared from the sight of the sponsor and the guests on the launching platform before she was even afloat. The gradual and complete disappearance of the great vessel was almost uncanny and a quite new experience for everyone who was present.

The *Gulfpride* will be ready for sea about April 1, at which time we expect to publish a detailed description of the ship and her propelling machinery.

Two Million Appropriation for Extending Government Barge Fleet

AT a conference held at Washington, D. C., on Wednesday, December 29, between President Coolidge and Budget Director Lord, an appropriation of $2,000,000 for operation of an additional fleet of barges on the upper Mississippi river was agreed on. This sum will complete the $5,000,000 stock authorized for the Inland Waterway Corporation which will operate the barges. It is estimated about $1,000,000 will be required to build new boats and facilities and the remainder will be necessary for the addition of terminals.

The appropriation will go to Congress as a special budget recommendation, as soon as the hearings have been completed. It is expected it will be placed in the hands of the House Appropriations Committee in two weeks but the hearings may delay this step. If approved, the sum will be placed in a deficiency appropriation bill.

Shipping Board Sells Two Tankers to Chile S.S. Co.

THE United States Shipping Board has accepted the proposal of the Chile Steamship Company, Inc., 25 Broadway, New York City, of $420,000 each for the 7,500-deadweight ton tankers *Cabrille* and *Lilmae*, bids for the sale of which were received on January 17. The tankers are equipped with reciprocating engines and Scotch boilers. The former is laid up at Mobile, Ala., and the latter at Philadelphia, Pa.

Tenders for the two tankers *Darden* and *Gladysbe* were rejected. New proposals for these two tankers will be received until noon February 7.

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MARINE NOTES FROM THE GREAT LAKES

Huron Transportation Co. Places Contract for Freighter with Great Lakes Works

THE Great Lakes Engineering Works with plants at River Rouge, Mich., and Ashtabula, Ohio, has received a contract for the construction of a steel freighter of the most modern stone-carrying type from the Huron Transportation Company, Detroit, Mich. This company is a subsidiary of the Huron Portland Cement Company. Paul H. Townsend, superintendent of the cement concern, stated that the vessel will have a length of 400 feet and a carrying capacity of 7,000 tons. The ship will be slightly larger than the *John W. Boardman* and *Samuel Mitchell* of the Huron Transportation Company's fleet. The ship will be driven by a triple expansion engine of approximately 2,000 horsepower. Steam will be supplied by 3 Scotch boilers having a diameter of 13 feet and a length of 11 feet equipped with an adjusted draft system.

The ship, which will cost about $1,000,000, will be equipped with a modern conveyor system for loading and discharging cargoes and will be operated in the cement carrying trade running out of Alpena to Detroit, Milwaukee, Duluth, Cleveland and other ports. The contract calls for the completion of this vessel by October 1, 1927.

Car Ferry Madison Christened with Milk

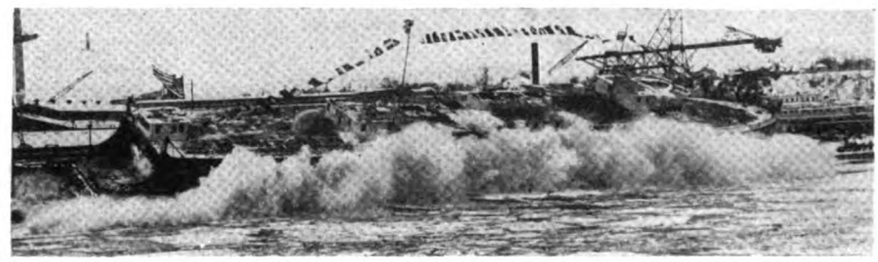
THE car ferry *Madison*, which is the second vessel of its type to be built at the Manitowoc Shipbuilding Corporation, Manitowoc, Wis., for the Grand Trunk Railway Systems, was launched January 19. A most unusual feature of this launching is the fact that a bottle of selected Wisconsin milk was used to christen the vessel. This rather unique method of christening was employed because of the great importance of the milk industry in the state, which probably ranks first among the great dairy centers of the United States.

The *Grand Rapids* was the first ferry of this type to be placed in service and was delivered several weeks ago for operation between Benton Harbor, Mich., and Milwaukee, Wis. Each of the two new car ferries is 360 feet long with a beam of 56 feet and a depth of 21 feet 6 inches. In each vessel steam is supplied by four Scotch marine boilers, while the main propelling machinery consists of two triple expansion engines.

Car ferry Madison ready for launching

The ferries are arranged with four tracks and provide a carrying capacity for 30 of the largest type freight cars. They are designed for heavy winter service and extreme ice conditions. The construction of these vessels was under the general supervision of Captain Charles E. McLaren, manager of car ferries of the Grand Trunk Railway System with offices in Milwaukee, Wis.

Among the important products used in the construction of these vessels was Haskelite for bulkheads, paneling, etc., and Plymetl for doors.



The Madison goes overboard at Manitowoc shipyard

Lake Yards Busy with Repairs

MOST of the Great Lakes shipyards have lined up much repair work for the remainder of the winter. Some of the plants will be extremely busy until navigation opens. The steamer *Venus* of the Interlake Steamship Company is being reconstructed along the same lines as the *Lagonda* which was fitted out a year ago to carry scrap and all kinds of steel.

Four steamers of the Interlake fleet will be fitted with new tank tops before spring comes.

The steamer *S. B. Way* of the Valley Camp Steamship Company will be a self-unloader when she goes into service this season and may be withdrawn from the lake ore trade. According to plans now of some of the big lake transportation companies, several freighters will be shifted this spring and will not be in the same trade they were in last year. Another steamer may be added to the automobile carrying fleet.

The car ferry steamer *Pere Marquette XVIII* which went ashore at Fox Point, near Milwaukee, has been dry docked at Manitowoc for repairs. The steamer Carl D. Bradley has been dry docked at the River Rouge. She has 18 damaged plates.

The lake freighter *Thomas Maytham* was floated out of the dry dock of the Toledo Shipbuilding Company, January 18, after undergoing extensive repairs. She went ashore in Lake Superior late during the 1926 navigation season.

Repairs on the steamer *B. H. Taylor*, which was dry docked at the River Rouge yard, were also completed. The steamer *W. F. White* followed the *Taylor* into the River Rouge dry dock for repairs on her bottom. The *White* has 18 damaged plates.

Vessels Lost on the Lakes in 1926

Property losses on the Great Lakes during the 1926 navigation season exceeded those in 1925, but all the vessels which passed out of existence were small. Nine steamers and one barge were lost, the largest vessel having a capacity of 3,000 tons and the total trip capacity of the nine ships lost was but 17,000 tons. Three lives were lost on the sand steamer *H. S. Gerken* which foundered off Erie, Pa., August 21, while in 1925 the life loss was 21 persons. Fifteen vessels were lost in 1924, having a total trip capacity of 36,500 tons. Fifteen boats were lost in 1923, having a total trip capacity of over 27,000 tons. Two steel steamers were stranded in Lake Superior in 1926. The *City of Bangor* went ashore at Keweenaw Point but was not abandoned by her owners and may be a total loss. The steamer *Cottonwood* is ashore at Copper Mine Point. She is not insured. The steamer *Thomas Maytham* with a cargo of grain downbound went ashore in Lake Huron but was released and went into dry dock for repairs at Toledo.

In addition to these losses the underwriters will have some good wrecking and repair bills to meet. Quite a few vessels at the end of the 1926 season were compelled to go into shipyards for repairs due to strandings and ice collisions. The vessels lost in 1926 were the *Charles Horn*, in Lake Ontario; *N. Grammer*, Lake Ontario; *Northwind*, Georgian Bay; *H. S. Gerken*, Lake Erie; *Zillah*, Lake Superior; *A. D. MacTier*, Lake Ontario; *H. Houghton*, St. Clair river; *H. H. Hettler*, Lake Superior barge; *Michigan Central*, Lake Huron. The *MacTier* had a trip capacity of 3,000 tons; the *Northwind*, 3,200 tons; the *Charles Horn*, 1,200 tons; the *Gerken*, 2,300 tons; the *Grammer*, 2,400 tons.

Licensed Tugmen Elect Officers

Captain Thomas J. Burns, of Kenmore, on January 11, at a meeting of the licensed tugmen on vessels in the Lake Carriers' Association, was elected president. The meeting was held in Buffalo. George R. Grazer of the steamer *Stifel* was made vice-president and A. J. Zimmer, assistant commissioner of the association at Buffalo, secretary-treasurer. George A. Marr, of Cleveland, secretary of the association, at-

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tended the meeting and urged a more general use of the Buffalo quarters for social and entertainment purposes. Some questions regarding navigation laws and vessel regulations were discussed by Mr. Marr and others.

New Cleveland-Detroit Passenger Service

It was announced in Cleveland the first of the New Year that James Playfair and associates will place passenger vessels in service between Cleveland, Detroit and points of interest along the shores of Georgian Bay. The steamers will call at Goderich, Owen Sound and Midland with special arrangements for passengers at Midland wishing to take the inside channel to Parry Sound. The first steamer to be put into service will be 400 feet long, with a 50-foot beam.

Shipmasters' Association Holds Meeting

At the annual election of Cleveland Lodge No. 4 of the International Shipmasters' Association, W. H. McLachlin was made president and C. L. Allen secretary. The annual meeting of the Grand Lodge convened in Milwaukee, January 25.

Captain T. Howard Saunders, commander of the steamer *M. A. Bradley*, has been elected president of the Buffalo Lodge of the International Shipmasters' Association. He is 34 and the youngest man ever elected to the place. Captain William MacDonald is first vice-president.

Launchings

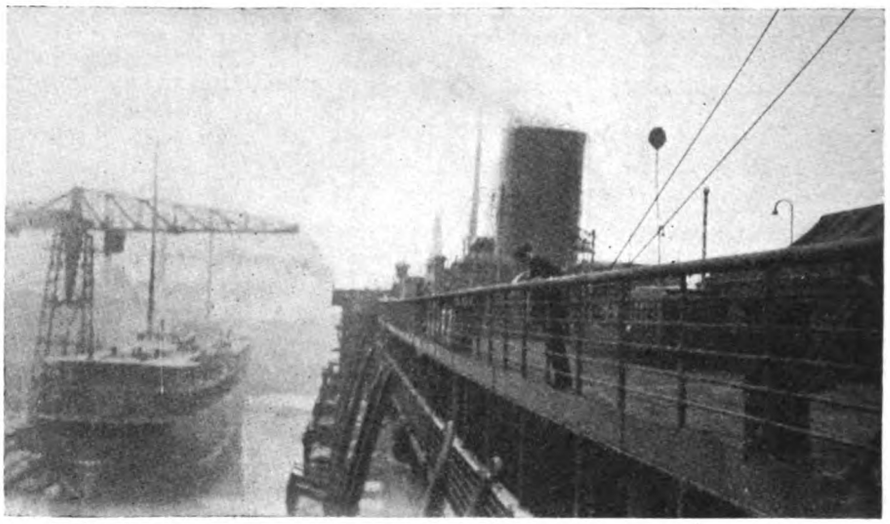
The big lake freighter being built for the Inland Steamship Company at the Lorain yards of the American Shipbuilding Company was launched last month. She was named for L. E. Block, chairman of the Inland Steel Company, and will be a practical duplicate of the *Fred G. Hartwell* which went into service in 1922. The *Block* will be the fourth of six big lake freighters now in construction at the same yards.

The steamers *City of Montreal* and *City of Hamilton* have just been launched at the yards of the Midland Shipbuilding Company. The vessels will be operated between Montreal, Toronto and Hamilton. Two more steamers of the Welland canal type are now being built for the Canada Steamship Lines at the Midland yards.

According to reports received in Cleveland the steamer *City of Bangor*, which went ashore at Keweemaw Point, is so badly damaged the ship may be considered a total loss. Ice cut a hole in the steamer from the engine gangway to the stern frame on the outboard quarter deck. Her boiler rooms are full of water. The vessel was bound for Duluth and carried 200 automobiles. The work of salvaging them has been undertaken.

The steamer *Saskatchewan* loaded with grain was hit by the steamer *R. J. Paisley* which broke her tow line at Owen Sound. The *Paisley* was damaged as was the other vessel and both ships will go to the yards for repairs.

Stephen Clergy, aged 67, for many years one of the most widely known marine engineers on the Great Lakes, died in Buffalo, January 8. He followed the lakes for over 40 years.



Getting up steam on the Matson liner Malolo for the first time

Lloyd's Shipbuilding Returns for 1926

A SHARP decline in the world's production of merchant vessels marked 1926, launchings for that year totaling over half a million gross tons less than in 1925, says a statement just issued by Lloyd's Register of Shipping, covering returns from all countries for ships of 100 gross tons and upwards.

While the launchings for 1926, aggregating 1,674,000 gross tons, were only about half the total for the last pre-war year, 1913, they were less than a quarter of the figure for the post-war peak year, 1919; and, with the exception of 1923, the 1926 total is less than for any year since the war, Lloyd's Register points out.

The United States was one of the few countries to show a gain last year, in comparison with 1925. Great Britain and Ireland's shipyards showed a pronounced loss in the total of tonnage launched in 1926, and a decline, but a much smaller one, was made by the other maritime countries, taken together.

The comparison of the launchings for the last two years is shown in the following table, prepared by Lloyd's, the figures representing gross tons:

	1926	1925
United States	150,613	128,776
Great Britain and Ireland.	639,568	1,084,633
Other countries	884,796	979,995
World total	1,674,977	2,193,404

As against the drop of 518,000 gross tons for all countries during the last year, the 1925 total shows a decrease of only 54,000 tons from that for 1924. The 1926 figure, however, is only about 30,000 above the low mark registered in 1923, of 1,643,000 tons.

Tanker Construction

Tanker construction during 1926 showed a decrease of about 15 percent, as compared with the previous year, although there was a gain recorded for American shipyards. The 1926 launchings, however, were more than double those of this type of vessel in 1924, when only 116,000 tons were sent down the ways of all countries. Lloyd's Register gives the following comparison of launchings of tankers in the past two years, in gross tonnage:

	1926	1925
United States	10,166	1,217
Great Britain and Ireland...	100,020	134,766
Other countries	136,311	150,886
World total	246,497	286,869

The decrease in the construction of sailing ships and barges was continued last year, only 44,843 gross tons of this class of vessels being launched, as compared with 51,079 tons in 1925.

Motorship Launchings

While a decline of about 140,000 gross tons in launchings of motorships was shown last year, as compared with the figures for 1925, the proportion of vessels equipped with internal combustion engines continues to increase, 42 percent of the 1926 launchings being represented by this type, as against 39 percent in 1925. Seven motor vessels, each of 10,000 gross tonnage, or over, were sent down the ways last year; the same number of large sized types as were launched in 1925.

Italian shipyards launched a greater tonnage of motor vessels in 1926 than in 1925; but the reverse was the case with Great Britain and Ireland, and with the other maritime countries, taken together. The contrast in launchings between the two years is shown by Lloyd's in the following table of gross tonnage:

	1926	1925
Great Britain and Ireland...	201,913	267,217
Italy	153,121	101,479
Other countries	348,972	474,933
World total	704,006	843,629

The rapidity of the growth of motorship construction is shown by the comparison of launchings of that and other types of vessels during recent years. In 1921, of all the tonnage sent down the ways, only 7¾ percent was of vessels equipped with internal combustion engines; while last year the proportion had increased to more than two-fifths of the total of production of all types of shipping.

Turbine-Driven Vessels

Vessels equipped with steam turbines which were launched last year represented 301,000 gross tons, as compared with 262,000 tons in 1925. Growth of the tendency towards the use of turbines has been reflected in the recent quarterly returns of shipping under construction throughout the

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world, and there has been a corresponding decrease in the equipment of new vessels with steam reciprocating engines.

OUTPUT OF GERMAN YARDS DECLINES

One feature of the returns of launchings of all types of vessels during 1926 is the falling off in the production of the German shipyards. The tonnage sent down the ways in that country last year was less than half the total for 1925. As a result, Germany, which was exceeded in output only by Great Britain and Ireland in 1925, dropped to third place in the relative ranking of shipbuilding countries; second place being taken by Italy, which stood third in 1925. Italy's launchings last year aggregated 77,000 gross tons more than in the previous year.

The United States retained fourth place, and its increase of 21,000 tons put it less than 30,000 tons behind Germany, as compared with a gap of over 275,000 tons in 1925. Fifth place is now held by France, which was sixth in 1925. French launchings for 1926 were 45,000 gross tons in excess of her 1925 figure. The gain of the French shipyards forced Holland from fifth to sixth place, although the Dutch builders launched more tonnage last year than in 1925. Denmark retained seventh position, although launching about a thousand tons less than in 1925; but Japan, with about 3,000 tons less sent down the ways than in 1925, yielded eighth place to Sweden, which had been ninth. Sweden's 1926 production was only about 200 tons less than in the previous year.

RANKING OF VARIOUS COUNTRIES

Great Britain and Ireland, however, showed the greatest decline from the 1925 figures, the decrease amounting to nearly 450,000 tons. The ranking of the various countries and the contrast with the 1925 position are shown in the following table of gross tonnage, prepared by Lloyd's.

	1926	1925
Great Britain and Ireland..	639,568	1,084,633
Italy	220,021	142,046
Germany	180,548	406,374
United States	150,613	128,776
France	121,342	75,569
Holland	93,671	78,823
Denmark	72,108	73,268
Sweden	53,518	53,750
Japan	52,405	55,784

The proportionate share of Great Britain and Ireland in ship production was lower last year than in any year since 1920. In 1913, 58 percent of all launchings were in British and Irish yards. In 1919, however, their share of the total was only 22 percent. From this point it advanced to 35 percent in 1921, to 39 percent in 1923, jumped to 64 percent in 1924, and then declined to 49 percent in 1925, and last year was only 38 percent.

The shifts in the American share of the world's output of shipping have also been sharp. In 1913 only 8 percent of the launchings were in this country; but in 1919 the proportion jumped to 57 percent. A steady decline followed until 1922, when the United States' share was only 5 percent. The following year it advanced to 10 percent, and then receded to 6 percent in 1924 and 1925. Last year, however, 9 percent of the world's launchings were in this country.

For the other shipbuilding countries combined, last year's proportion was as high as in any year since the war. In 1913 these nations had 34 percent of the total launchings; and in 1919 only 21 percent. From this point it continued to advance, until in 1923 it was 53 percent. In 1924 it had dropped to 30 percent, but jumped to 45 percent in 1925, and to 53 percent last year.

During 1926, twenty-two steamers, each of 10,000 gross tons or over, were launched throughout the world, Lloyd's Register states. This represents an advance over 1925, when the total of large steamers sent down the ways was sixteen.

Progress of the Isherwood System of Ship Construction and of the Bracketless-System

THE following table shows the yearly progress made in the adoption of the Isherwood system of ship construction throughout the world.

Year	Number of Ships Built or under Construction	Deadweight Carrying Capacity Tons
Sept 1907 to Dec. 1908	6	31,608
1909	36	212,992
1910	76	484,752
1911	140	958,795
1912	240	1,777,348
1913	270	1,993,034
1914	311	2,351,322
1915	468	3,548,221
1916	620	4,666,000
1917	800	6,332,150
1918	1,050	8,707,700
1919	1,260	10,594,700
1920	1,395	11,962,400
1921	1,418	12,032,400
1922	1,431	12,101,890
1923	1,443	12,174,490
1924	1,472	12,408,700
1925	1,502	12,649,730
1926	1,551	13,096,480

The outstanding feature of interest in connection with this year's contracts is the progress made by the "bracketless-system," which eliminates the bulkhead brackets in oil tanker construction. In six months after the completion of the first vessel 12 contracts have been placed, making a total of 14 ships, aggregating about 180,000 tons deadweight carrying capacity.

The first vessel built on the "bracketless-system"—the *British Inventor*—which was purchased by The British Tanker Company, Ltd., and put into service in July last, has proved a complete success. Although this vessel encountered rough passages during two round voyages, upon examination in dry dock no strain whatever was discernible and the result of the inspection was highly satisfactory in every respect to many experts present.

The contracts awarded this year on the new system include a second tanker building by arrangement between Sir Joseph W. Isherwood, Bt., and Messrs. Palmers Shipbuilding & Iron Company, Ltd., four large vessels by Scandinavian shipbuilders, two by French shipbuilders for the Compagnie Auxiliaire de Navigation of Paris, one 21,000-ton tanker for the Standard Oil Company of New Jersey, and three to be built in British yards, two of the latter being for the important Canadian owners—the Imperial Oil Limited of Toronto—to be constructed under the supervision of Sir Joseph W. Isherwood, Bt.

Apart from the enthusiasm displayed in the latest invention for oil tankers, it is interesting to observe that old clients of the "Isherwood" system have shown their confidence in it by placing further repeat orders, among which are three important vessels similar to one placed last year (to be fitted with twin screw machinery) for service in transporting oil from Maracaibo to the Caribbean Sea to be discharged into ocean-going ships. These vessels, which are also building by Messrs. Palmers Shipbuilding & Iron Company, Ltd., are of special design, embodying the maximum strength with the minimum amount of weight in view of the light draft permissible.

Other vessels include a 13,000-ton tanker to be built in this country by the Sun Shipbuilding Company, a high-class passenger and cargo vessel for the Southern Pacific Company, a repeat order to Messrs. Lithgows, Ltd., Port Glasgow, for a duplicate of the *Pulpit Point* recently placed in commission by the Vacuum Oil Company, and two specially designed general cargo vessels to be built for Messrs. James Chambers & Company of Liverpool on the "Isherwood" combination system, which the owners consider ideal for the type of vessel intended for their general cargo trade.

The following is an analysis of the table of ships above referred to, showing the total number and tonnage of the various types for which the Isherwood system (including the bracketless-system and the Isherwood combination system) has been adopted:

General Cargo Vessels, Colliers, Ore Steamers, Passenger Vessels, Great Lakes Freighters and Passenger and Freight Ferry Vessels.

661 aggregating 5,888,830 tons deadweight carrying capacity.

Oil Tankers.

747 aggregating 7,128,060 tons deadweight carrying capacity.

Barges, Dredgers and Trawlers.

143 aggregating 79,590 tons deadweight carrying capacity.

TRADE PUBLICATIONS

GENERAL ELECTRIC EQUIPMENT.—The annual statement of orders received for 1926 by the General Electric Company, Schenectady, New York, and a review of recent achievements of this company are contained in a bulletin recently issued to the stockholders of the General Electric Company.

PROTECTIVE COATINGS FOR PREVENTING CORROSION.—The Dampney Company of America, Boston, Mass., has issued a booklet containing a description of Apexior, a surfacing material for preventing corrosion in boiler tubes and drums, steel tube economizers, feedwater heaters, steam turbines and other power equipment. A short general description of corrosion and requirements for its prevention is also included.

YACHT AND MOTOR BOAT AUXILIARIES.—New machines which have been added to the products of the American Engineering Company, Philadelphia, Pa., designed as auxiliaries for yachts and motor boats, are illustrated and described in a bulletin which was issued during the annual motor boat show in New York City. These machines include windlasses, hoists, davit winches, steerers and remote reverse control equipment.

STEAM TURBO GENERATORS.—The descriptive circular No. 100 dealing mainly with the operation and construction of steam turbines and generators as combined in one unit has been issued by the American Brown Boveri Electric Corporation, Camden, N. J. A number of special purpose Brown Boveri turbines are briefly described and illustrated in the early pages of this booklet. This section is followed by a discussion of turbines in general and turbo-generators in particular.

DROP FORGED TOOLS.—The Billings & Spencer Company, general offices and works, Hartford, Conn., have just issued a very elaborate hand book and catalog combined, of 122 pages, on their drop

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forged tools. It thoroughly covers wrenches of all types, eye bolts, chisels, clamps, dogs, ends, extensions, hammers, tool kits, nuts, pliers, punches, ratchets, screw drivers, thumb screws, sets, sleeves, sockets, cotter pin tools, etc. Anyone mentioning this magazine can secure a copy free of cost.

HASKELITE AND PLYMETL.—The third issue of "The Light Weight Champions' Record" which is the house organ of the Haskelite Manufacturing Company, Chicago, manufacturers of Haskelite and Plymetl, has recently been issued. This bulletin is devoted to a description of the uses to which Haskelite and Plymetl are being put in various industries. It contains a special article by James Raymond Fitzpatrick, C. E., secretary and director of sales, on "Building New Markets for Haskelite, War-Born Industrial Product." This article, which was reprinted from the January issue of "Industrial Marketing," deals with a number of applications of this material, including its uses aboard ship, where it makes a satisfactory bulkhead material for separating staterooms in passenger vessels, and has been used largely in new ship construction and reconditioning work by Atlantic coast and Great Lakes shipyards. A number of notable installations are mentioned including the liners *Leviathan, George Washington* and other United States Lines vessels; the Lake liners *City of Detroit* and *City of Cleveland. III* as well as in the Merchants and Miners and Norfolk and Washington boats. On the west coast, the latest vessels which have adopted Haskelite and Plymetl are the ferryboats for the Key System and the new vessels of the Los Angeles Steamship Company. On the new car ferry *Madison* for the Grand Trunk Railway System, now nearing completion, both Haskelite and Plymetl have been used extensively; on the former for bulkheads, interior side linings, ceilings, etc. and on the latter for exterior doors.

BUSINESS NOTES

L. H. Coolidge and H. C. Hanson, Seattle, Wash., naval architects, have formed a partnership with offices at 117 Grand Trunk dock.

William Z. Gardner, former president of the Propeller Club of the Port of New York, is now located at 136 Liberty street, New York, where he plans to handle advertising and marine publicity work.

Alexander McNab, president of the McNab Company, formerly of Bridgeport, Conn., is now located at No. 1 Broadway, New York. All correspondence regarding McNab marine inventions and auxiliaries should be forwarded to the new address.

The Air Reduction Company, Inc., has acquired, through a long-term lease from the Commercial Acetylene Supply Company, Inc., the plants and business of that company on the Pacific coast. The two acetylene manufacturing plants are located at Berkeley and Los Angeles, Cal., respectively.

George Solz, Jr., has been appointed by the Bridgeport Brass Company, Bridgeport, Conn., to sell their line of tubular plumbing supplies, brass pipe and fittings in Northern New Jersey and the Bridgeport-Keating flush valve in the entire state of New Jersey and Rockland County, New York.

Theodore Beran of New York, H. L. Monroe of Chicago and J. A. Cranston of San Francisco have been appointed commercial vice presidents of the General Electric Company, Schenectady, New York, in charge of the commercial activities of the company in the New York, central, and Pacific coast districts, respectively. E. W. Allen, manager of engineering, was elected vice president in charge of engineering with offices in Schenectady.

Anson Wood Burchard, vice-chairman of the board of directors and chairman of the executive committee of the General Electric Company and chairman of the board of directors of the International General Electric Company, died on January 22 of acute indigestion in New York City. He was 61 years old and was director of several utility and electrical companies and a member of many electrical and power clubs and organizations.

Harry E. Miller has been appointed works manager of the Newark, N. J., plant of the Westinghouse Electric and Manufacturing Company. Mr. Miller entered the employ of the Westinghouse Company at Pittsburgh in 1889 and was assigned to the machine and tool departments and later moved to the erection and test sections. Eleven years later he was transferred to the Newark factory as foreman of the inspection and tests of ampere and watthour meters and fan motors. Mr. Miller continued as an executive of the Newark plant, becoming successively assistant superintendent, superintendent, assistant works manager and finally manager.

James A. Davies, assistant general superintendent of the South Philadelphia Works, Westinghouse Electric and Manufacturing Company, for the past eight years, has been appointed general superintendent to fill the position made vacant by the death of Mr. H. M. Giles, widely known in engineering circles throughout the United States. Alfred Voysey was appointed to the position of assistant general superintendent formerly held by Mr. Davies and James Lyons was promoted to the position of supervising production department vacated by Mr. Voysey.

The American Brass Company announces that arrangements have been completed whereby it will take over the manufacture and sale of Everdur Metal from the Du Pont Everdur Company. Everdur is a trademarked and patented alloy of copper, silicon and manganese. It was developed by the Du Pont Company in their search for a metal that would combine the tensile strength and elastic limit of low and medium carbon steels with good machining and working qualities and high resistance to a large number of corroding agents. This alloy is manufactured by the American Brass Company in the form of casting ingots, plates, sheets, rods and wire, and is also available in the form of washers, bolts, nuts, screws, rivets, wire cloth and castings. It casts readily, can be drop forged, stamped and pressed. The research work conducted by the Du Pont Everdur Company in developing Everdur Metal will be continued by the American Brass Company in the further development of this material for various purposes in their laboratories.

Marine Societies

America

American Marine Association. 30 Church St., New York. President—Col. E. A. Simmons.

American Marine Standards Committee. Chairman, Colonel E. A. Simmons. Secretary, A. V. Bouillon, Division of Simplified Practice, Department of Commerce, Washington, D. C.

American Society of Marine Designers. Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass.

American Society of Marine Engineers. 605 Market St., San Francisco, Calif. President—Benjamin S. Free. Secretary—Wm. H. Thille.

American Society of Naval Engineers. Navy Department, Washington, D. C. Secretary-Treasurer—Commander H. B. Hird, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

American Steamship Owners' Association. 11 Broadway, New York. President—Alfred Gilbert Smith.

Atlantic Coast Shipbuilders' Association. 1600 Walnut Street, Philadelphia, Pa. Secretary—C. S. King.

Council of American Shipbuilders, Inc. 30 Church St., New York. President—Homer L. Ferguson. Secretary-Treasurer—Henry C. Hunter.

Jersey Marine Club, 4th and River streets, Hoboken, N. J. President—Col. Bartlett.

Lake Carriers' Association. President—J. S. Ashley. Secretary—George A. Marr, Rockefeller Building, Cleveland, O.

National Association of Engine and Boat Manufacturers. 29 West 39th Street, New York City. Secretary—Ira Hand.

National Association of Masters, Mates and Pilots. National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

National Marine Engineers' Beneficial Association. Headquarters, 311-315 Machinists Building. Washington, D. C. President—Wm. F. Yates. Secretary—Albert L. Jones.

National Merchant Marine Association. Munsey Bldg., Washington, D. C. President—Hon. J. E. Ransdell.

Neptune Association. 21 Pearl St., New York City. Secretary-Treasurer—Captain John F. Milliken.

New York and New Jersey Dry Dock Association, 111 Broadway, New York. President—Jonathan Moore.

Ocean Association of Marine Engineers. 15 Whitehall St., New York. Secretary—Bert L. Todd.

Port of New York Authority. 75 West Street, New York. Chairman—George S. Silzer. Secretary—Wilson J. Vance.

Society of Naval Architects and Marine Engineers. 29 West 39th Street, New York. Secretary and Treasurer—Daniel H. Cox.

The Maritime Association of the Port of New York. 78 Broad St., New York City. President—John Dowd. Secretary—John F. Manning.

The New York Tow Boat Exchange. 11 Moore St., New York. Manager—Charles A. Mason.

The Propeller Club of the Port of New York. President—Edward A. Colson, 85 Liberty Street, New York. Secretary—William C. Gray, 17 Battery Place, New York.

United States Naval Institute. Naval Academy, Annapolis, Md. Secretary and Treasurer—Captain H. A. Baldridge, U. S. N.

United States Ship Operators' Association. 149 Broadway, New York. President—Winchester Noyes.

Canada

Grand Council N. A. of M. E. of Canada. Grand Secretary-Treasurer—W. A. MacDonald, 62 Albert St., Halifax, N. S.

Great Britain

Institute of Marine Engineers, Incorporated. 85/88 The Minories, London, E.1.

Institution of Engineers and Shipbuilders in Scotland. 39 Elmbank Crescent, Glasgow.

Institution of Naval Architects. Adelphi Terrace, London, W. C.

Northeast Coast Institution of Engineers and Shipbuilders. Bolbec Hall, Westgate Road. Newcastle-on-Tyne.

France

Association Technique Maritime et Aéronautique. Secrétariat Général—7, rue de Madrid, Paris (8e).

Italy

Collegio Degli Ingegneri Navali e Meccanici in Italia.

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